CIVIL ENGINEERING

JULY 1965

THE MAGAZINE OF ENGINEERED CONSTRUCTION

ST. LOUIS AIR TERMINAL— See article by WM. C. E. BECKER

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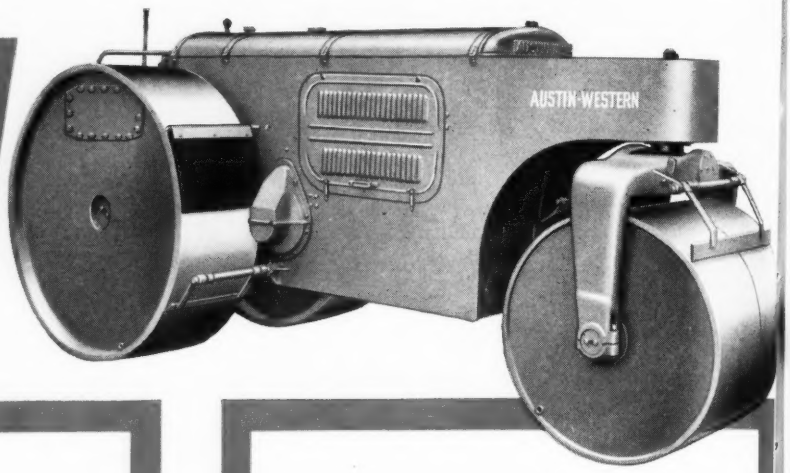

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- *NEW* **Torque Converter Drive** . . . smooth, powerful, flexible
- *NEW* **Variable Weight** . . . rolls designed for water or wet sand ballast
- *NEW* **Full-Width Seat** . . . with dual operating controls
- *NEW* **Visibility** . . . with low center of gravity, and high ground clearance
- *NEW* **Gasoline or Diesel Engines** . . . 2-speed or 4-speed transmissions
- *NEW* **Accessibility** . . . servicing all assemblies is quick and easy

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- *NEW* **Torque Converter Drive** . . . smooth, powerful, flexible
- *NEW* **Variable Weight** . . . rolls designed for water or wet sand ballast
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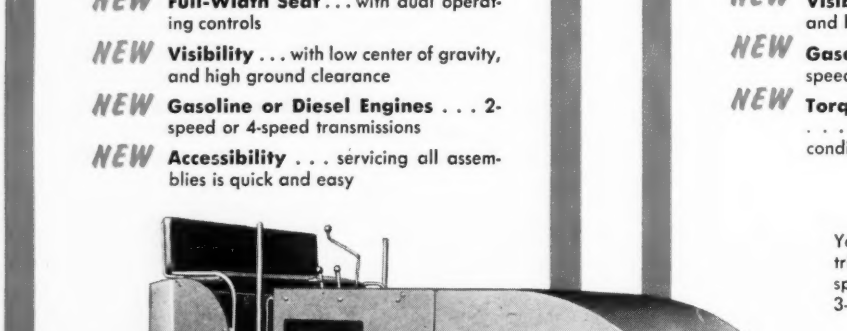

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CIVIL ENGINEERING

JULY 1955
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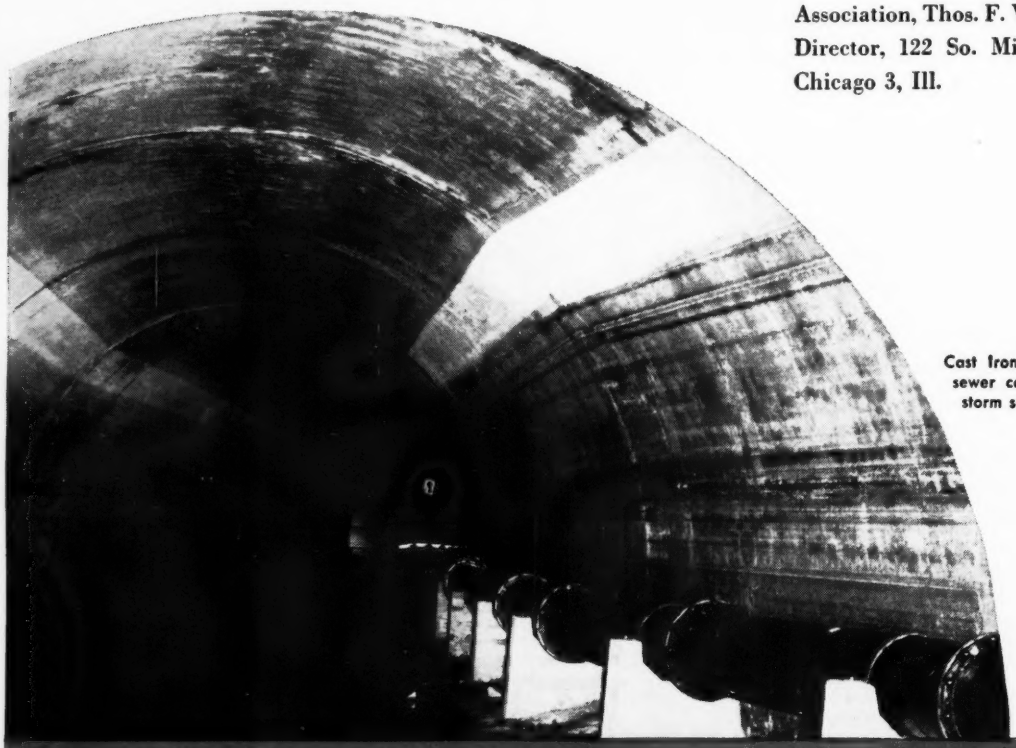
a TOUGH pipe for

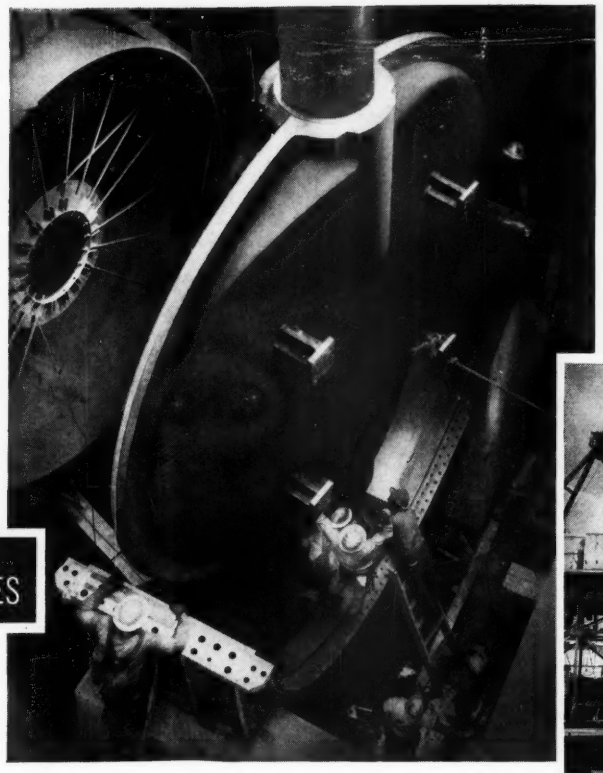
Industrial waste and other piping for large manufacturer in suburban Chicago, Ill.

Cast iron pipe has been famed for centuries as a rugged material with proved ability to withstand beam, compressive and shock stresses. Today's *modernized* cast iron pipe—centrifugally cast — is even tougher, even stronger and more uniform in quality. Its effective resistance to corrosion, plus high strength factors, ensure long life, underground or underwater. When an engineer needs a tough pipe for tough requirements, his first and last thought are usually: *specify cast iron pipe.* For information write Cast Iron Pipe Research Association, Thos. F. Wolfe, Managing Director, 122 So. Michigan Avenue, Chicago 3, Ill.



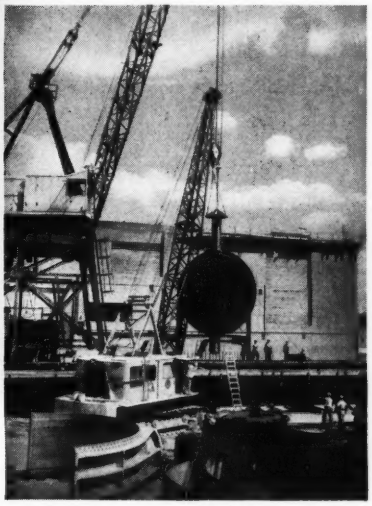
Cast Iron Pipe relief sanitary sewer constructed in existing storm sewer: Tulsa, Okla.

CAST IRON PIPE



An 18′ butterfly valve disc is shown here during installation at Blakely Mountain in Arkansas. Note the streamlining of the welded disc.

Photos—Vicksburg District, Corps of Engineers



SMS
BUTTERFLY VALVES

SMS VALVE SEALS CUT LEAKAGE TO MINIMUM

SMS Butterfly Valve seals cut leakage to a minimum. Disc seals are adjustable from either inside or outside, whichever is specified. Specially-developed SMS trunnion seals are essentially drop-tight.

With inside adjustment, the disc may be seated directly on the plate steel housing, as at Blakely Mountain, illustrated above, and as at Fort Peck, Montana. Here a 16 ft. dia. valve, recently tested after 14 years of service, had *less than ½ gpm leakage.*

SMS welded discs and housings assure greater freedom from the material defects of castings and permit more economical construction. The photo illustrates the streamlining possible with welded steel plate construction. This holds head losses and turbulence to a minimum.

SMS has designed and built butterfly valves in diameters from 3 inches to 18 feet, for service with operating heads up to 750 feet. For the assurance that your hydraulic equipment will meet or exceed specifications, you can rely on over three-quarters of a century of experience that SMS offers. For full information on butterfly valves, hydraulic turbines and accessories, write S. Morgan Smith Company, York, Pennsylvania.

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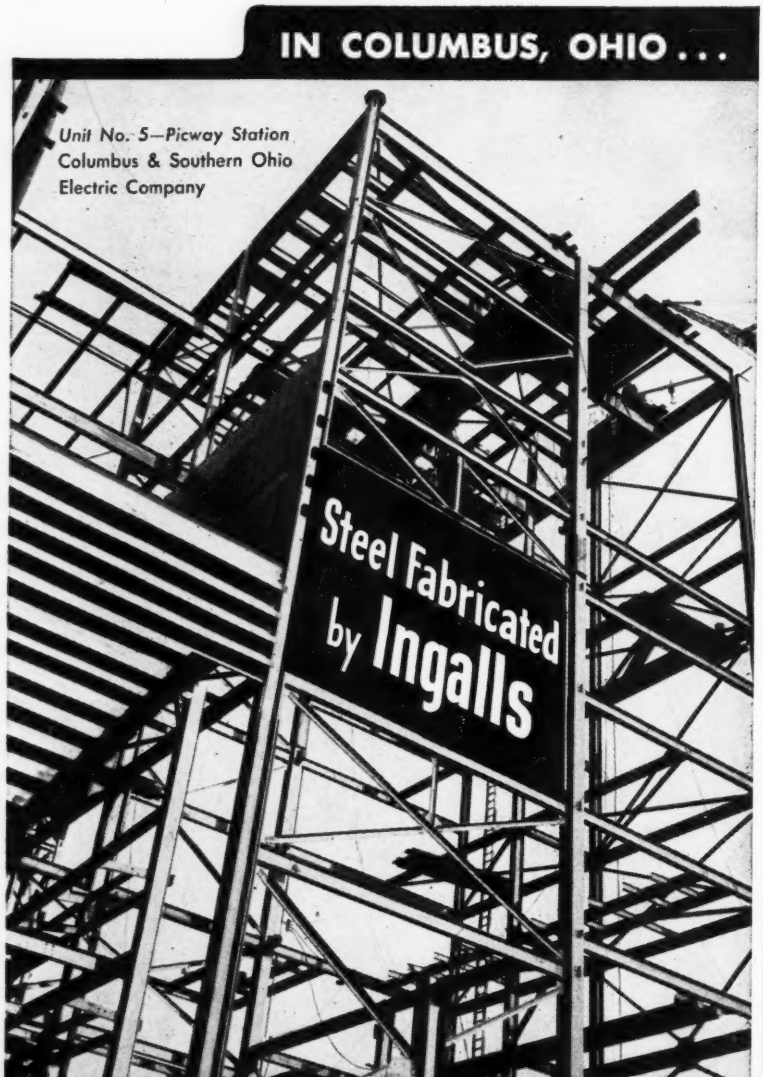
NEWS OF ENGINEERS

William Schuller, until recently structural engineer with Bellman, Gillett & Richards, Toledo, Ohio, has opened a consulting structural engineering office at 1248 Sylvania Ave. in Toledo. Previously Mr. Schuller was associated with Morton, Periera & Associates and Hazelet & Erdal, both of Chicago, and with Pierre Ghent & Associates of Washington, D.C.

George E. Barnes, head of the Department of Civil Engineering at Case Institute of Technology since 1933 and of the combined Department of Civil Engineering and Engineering Mechanics since 1944, has asked to be relieved of his administrative responsibilities as department head effective September 1. He will remain on the faculty as professor of hydraulics and sanitary engineering, devoting his time to teaching, research and consulting.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Paul D. Berrigan, Colonel, Corps of Engineers and division engineer for the South Pacific Division of the Corps at San Francisco, has been appointed division engineer for the North Central Division with headquarters in Chicago. Col. **William F. Cassidy,** assistant division engineer for the South Pacific Division since August, will succeed Colonel Berrigan as division engineer.

Alfred D. Hutchison, recently retired assistant district engineer of the Texas State Highway Department, has gone to London as consulting engineer on repair and rehabilitation of airfield pavements for the firm, Spencer J. Buchanan and Association, consulting engineers of Bryan, Tex.

Louis S. Dozier has been elected vice-president of Batson-Cook Co., West Point, Ga., one of the South's major construction firms. Mr. Dozier has been with the company since 1946 when he was released from the Civil Engineer Corps of the Navy with the rank of commander. His wartime service included design and construction of naval facilities in Florida, Oklahoma and Georgia, and duty with the Seabees in the Western Pacific and Japan.

Clyde L. Palmer, assistant city engineer for the City of Detroit, has been elected assistant treasurer and a member of the board of directors of the Engineering Society of Detroit. Mr. Palmer is a past-president of the Michigan Section of ASCE.

Theodore K. Rothermund, of Mount Bethel, Pa., has been appointed district highway engineer of the nine-county Harrisburg area, with headquarters in Harrisburg. From 1949 until 1954 Mr. Rothermund was employed as a consulting engineer for Devanco, Inc., New York, and the W. W. Slocum Co., Newark, N.J. Lately he has had his own consulting practice, specializing in road, dam, and site valuation projects.

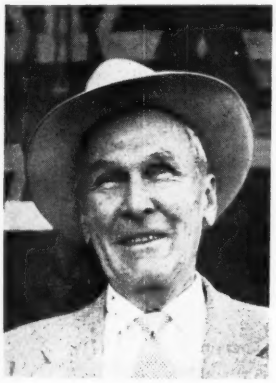
Herman W. Van Loo, acting regional engineer for the Bureau of Reclamation's Region 3, has been transferred to Yuma, Ariz., as Yuma projects manager. Mr. Van Loo has been construction engineer for the Bureau on the Coachella Division of the All-American Canal System. He succeeds **Murray J. Miller,** who has been transferred to Boulder City as regional engineer in charge of design and construction activities for projects in Region 3.

Marshall P. Anderson, since 1946 chief engineer for Brown & Root, Inc., Houston, Tex., has been made a vice-president of the firm. Connected with the company since 1937, Mr. Anderson has had overall responsibility for its design and construction activities.

Benjamin B. Talley, Brigadier General, Corps of Engineers, has been assigned to the Corps of Engineers Mediterranean Division with headquarters at Nouasseur, French Morocco. General Talley, who has been division engineer for the North Atlantic Division in New York City since 1952, recently received his general's insignia (May issue, page 25).

Benjamin F. Fairless, who recently retired as chairman of the Board and chief executive officer of the United States Steel Corporation (June issue, page 20), has been elected president of the American Iron and Steel Institute. Mr. Fairless is currently chairman of U.S. Steel's newly-formed executive advisory committee and company director. He recently received an honorary doctor of laws degree from Adelphi College at its commencement excercises in June.

William R. Bandy received the Distinguished Service Award from the Secretary of the Interior at a Distinguished Service Award Convocation in Washington, D.C., on May 16. The award was for outstanding service in the execution of



W. R. Bandy

public land surveys, and in dealing with problems concerning the ownership and survey of lands bordering on rivers formed by erosion and accretion. Mr. Bandy was area cadastral engineer for Area 3 of the Bureau of Land Management until he resigned last December to enter private practice in Billings, Mont.

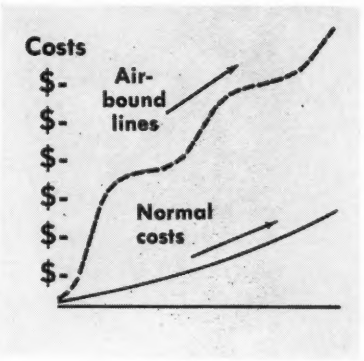
(*Continued on page 25*)

COST CUTTING

HOW TO CUT PUMPING COSTS

• When air lodges in high spots, it cuts the effective area of pipe, creates a friction head, lowers pumping capacity . . . and may cause water-hammer.

Simplex Air Release Valves end these troubles. They vent air automatically to eliminate binding, increase efficiency, cut pumping costs. Simple, rugged 2" size, for up to 250 psi., costs you little, quickly pays for itself! BULLETIN 1204



HOW TO PREVENT PIPELINE COLLAPSE

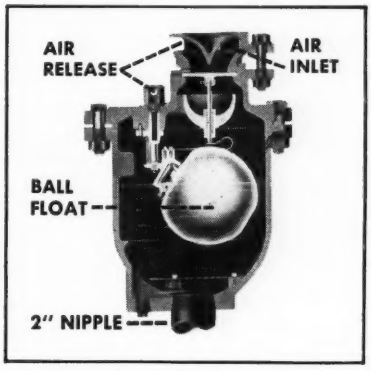
• A break in the line or a quickly opened valve often releases water at terrific velocity. Internal pressure falls below atmospheric. Thin-walled pipelines collapse!

Simplex Air Inlet Valves quickly admit air, prevent a vacuum, protect lines from collapse. They also vent air when lines are being filled to stop binding, increase efficiency. Standard 4" to 10" sizes. BULLETIN 1202

Pipeline collapse due to vacuum

HOW TO IMPROVE YOUR SYSTEM

• Here's a new way to increase pumping efficiency and prevent pipeline collapse . . . at low cost. One unit, Simplex Type AV Valve, does 3 jobs. It admits air to break vacuums, prevents pipeline collapse. Releases air to prevent binding, cuts pumping costs. Vents large volumes of air when system is filled . . . saving you the cost of buying large valves for this limited use. Dimensions only 11⅝" x 16¼". Easy to install . . . one 2" connection. BULLETIN 1205



New combination inlet-release valve

WRITE for Technical Bulletins! Simplex Valve & Meter Company, Dept. CV-7, 7 E. Orange St., Lancaster, Pa.

Accurate instruments and controls since 1904

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Raymond COMPLETES

ANOTHER CONTRACT FOR MAGNOLIA

ONE OF THE NICEST TRIBUTES any company can receive is the return of a satisfied customer. Three times Magnolia Petroleum has turned to Raymond with their foundation problems. At their Beaumont, Texas Refinery (part of which is shown above), four structures rest on over 32,000 feet of Raymond Standard Piles. Naturally, we're proud of these repeat performances. But we also enjoy welcoming new clients to the list of those we have worked with for a good many years. May we be of service to you?

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in principal cities of the United States, Canada, Central and South America.

News of Engineers

(*Continued from page 23*)

Francis M. Tompkins announces the formation of the Chesapeake and Colorado Uranium Corporation, of which he is president. Headquarters of the new organization will be in Washington. Mr. Tompkins is senior vice-president of the Chas. H. Tompkins Co., in Washington.

Alexander W. Dann, executive vice-president of the Dravo Corporation, Pittsburgh, retired this June after forty-two years with the company. In 1930 he was elected vice-president and director of the corporation and in 1934 became executive vice-president. Active in many organizations identified with river transportation and construction, he has been president and board chairman of the Mississippi River System Carriers Association (now American Waterways Operators, Inc.) and vice-president and director of the Union Barge Line Corporation, a Dravo subsidiary.

A. W. Dann

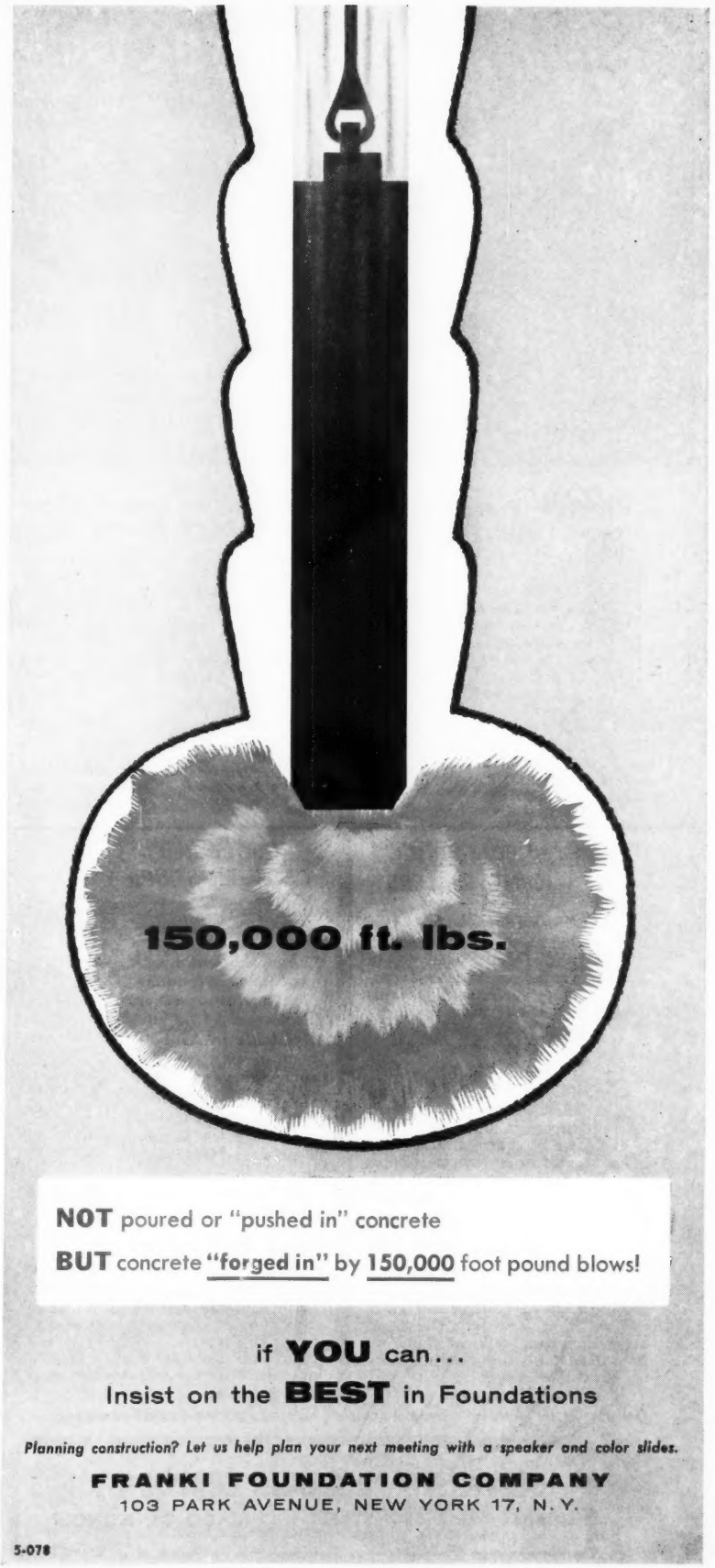
Carlo Semenza, of Lido-Venezia, Italy, was recently awarded the honary Doctor of Technical Science Degree by the Technical Hochschule of Munich. The title was conferred for "his activity in the field of the scientific analysis and construction of large dams and underground power stations, as well as in promoting cultural exchanges between German and Italian technicians." Mr. Semenza is director and chief engineer of the hydraulics construction department of Societa' Adriatica di Elettricita' at LidoVenezia.

Kenneth D. Cunningham, with the American Bridge Division of U.S. Steel, Pittsburgh, Pa., since 1939, has been named assistant division engineer. Before his promotion, Mr. Cunningham was design engineer.

Willard W. Warzyn recently resigned as chief structural engineer for Mead and Hunt, Inc., Madison, Wis., to open his own office, the Warzyn Engineering & Service Co., 2702 Monroe St., Madison. The newly formed organization will do soil boring and soil sampling as a part of its specialized work of foundation and structural engineering.

William W. Holman, for the past four and a half years on the research engineering staff of Rutgers University, has joined the soils engineering staff of Greer and McClelland, consulting engineers of Montclair, N.J. While Mr. Holman was at Rutgers he received a masters' degree in civil engineering.

(*Continued on page 26*)


150,000 ft. lbs.
NOT poured or "pushed in" concrete
BUT concrete "forged in" by 150,000 foot pound blows!
if YOU can...
Insist on the BEST in Foundations
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KORK-PAK *Premolded JOINT FILLER*

KORK-PAK — an exclusive Servicised development — *is the lowest cost non-extruding joint filler on the market.* Composed of cork granules bonded together with asphalt between two sheets of asphalt paper, KORK-PAK is resilient — recovers more than 80% of original thickness after compression — and has high resistance to moisture absorption. Readily handled without. breakage.

Hot Poured Para-Plastic JOINT SEALER

Forms a resilient, adhesive and effective plastic seal which maintains bond down to sub-zero temperatures. Para-Plastic JF Sealer recommended for sealing joints exposed to disintegrating action of petroleum solvents. Both types may be pumped directly from melting kettle into joint. Adheres to concrete, steel, etc.

Joints compressed in warm weather temperatures

Joints opened in sub-zero temperatures

Premolded Para-Plastic JOINT SEALERS

Used in keyed construction joints.

Sealing at footing.

Para-Lateral sealing rear face of wall.

MOLDED *Para-Plastic*

For sealing keyed contraction or construction joints in vertical or horizontal concrete surfaces. Maintains bond at temperatures down to 0° F and insures a resilient, moisture-tight seal.

Para-Lateral Strip

Designed for sealing backfilled vertical construction or expansion joints in retaining walls, abutments, foundations, wing wall, etc. against seepage to exposed side. Rigid backing may be nailed directly to forms, or strip may be applied to poured wall.

Corrugated CLOSURE STRIPS

A complete line for sealing corrugated construction against weather elements and heat loss. Available in Asphalt composition, rubber composition or KORK-PAK. KORK-PAK is most resilient non-sagging type and is low in cost. Types available for steel, asbestos cement, aluminum and corrugated glass sheets.

Inner and Outer closure strips sealing cove and outer wall.

Inner closure strip sealing corrugation at foundation.

RUBBER WATERSTOPS

A complete line of Flat Dumbbell, Hollow Bulb and fabricated tee's and ell's available. New Split Dumbbell Type eliminates split bulkheading, saves time and labor. Write for special Waterstop Catalog.

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News of Engineers

(*Continued from page 25*)

Harry H. Bagley, Captain, Civil Engineer Corps, U.S. Navy, who has been attending the National War College for the past year, has been assigned to duty in the Office of the Joints Chiefs of Staff, Washington, D.C., where he will be a member of the Construction Team of the Joint Logistics Plans Group.

Nathan B. Higgins, since 1942 president and director of the Safe Harbor Water Power Corp., Baltimore, Md., retired on May 31 after forty-one years of service in the electric industry. Mr. Higgins joined the Pennsylvania Water & Power Co. in 1914 in its Baltimore office and became assistant chief engineer when the Safe Harbor Water Power Corp. was formed. In his association with the two companies, Mr. Higgins has been responsible for the completion of the Holtwood hydroelectric and steam-electric projects and the Safe Harbor hydroelectric and steam-electric projects and the Safe Harbor hydroelectric project on the Susquehanna River.

Adolph J. Ackerman, consulting hydroelectric engineer of Madison, Wis., has been appointed to a George A. Miller visiting professorship in civil engineering at the University of Illinois. His appointment is for one semester and will begin in September.

Walter W. Weir received the John Deere Gold Medal of the American Society of Agricultural Engineers at the organization's annual dinner held at the University of Illinois, June 14. Drainage engineer for the University of California since 1926 and drainage engineer emeritus since 1954, Mr. Weir was cited "for distinguished achievement in the application of science and art to the soil." He has served on the Governing Council of ASAE, and for ten years was secretary of the State Soil Conservation Commission.

W. W. Weir

Francis S. Friel, president of the Philadelphia firm, Albright & Friel, was recently elected president of the Pennsylvania Section of the American Water Works Association. Mr. Friel, a former Director of ASCE, is also president of the American Institute of Consulting Engineers.

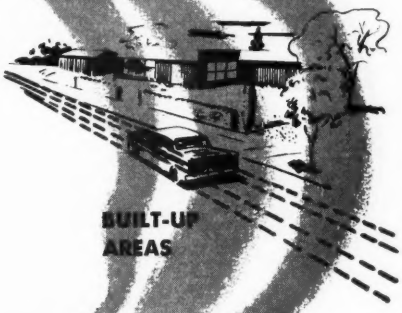
Mendel Glickman, professor of engineering at the University of Oklahoma School of Architecture, Norman, Okla., has been given a Fulbright award. He will lecture at the National Polytechnic Institute in Athens for ten months beginning in September.

(*Continued on page 28*)

CORROSIVE SOILS

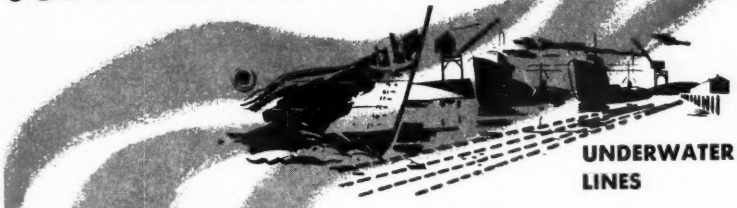
Soils of resistivities under about 2,000 ohm-cm, or soils of widely varying resistivities averaging even 5,000 ohm-cm or more, are usually quite corrosive. For such soils Somastic® Pipe Coating is the ideal solution. To avoid the expense of frequent changes in pipe treating equipment and crews on long lines, Somastic Pipe Coating should be used in sections of perhaps five to ten miles minimum length through such soils, even though intermediate stretches were of higher resistivity.

Where leakage cannot be tolerated...



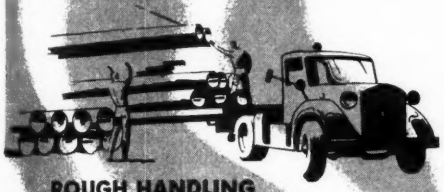
BUILT-UP AREAS

Wherever pipe lines traverse city streets and subdivisions or valuable agricultural property, or lands that may soon be converted to such use, Somastic Pipe Coating is recommended. This added precaution is a good investment against the cost and public ill will that would result from a leak, even though soil studies may not indicate that severe corrosion should be anticipated. A further factor in such locations is that supplementary cathodic protection may not be feasible on poor coating because of the difficulty of obtaining suitable anode locations.



UNDERWATER LINES

Somastic Pipe Coating has long been the standard for swamp construction, river and harbor crossings, and coated submarine lines. Experience indicates that submarine lines and river crossings can be installed when Somastic Pipe Coating is used without the expensive handling precautions normally required for other coatings. Examples of such use can be supplied including submarine lines in the Persian Gulf, in Lake Maracaibo and in the Pacific.



ROUGH HANDLING

Although Somastic Pipe Coating can be damaged by unusually rough handling, it is true that it can be installed with a minimum of damage under conditions of mountainous terrain where prewrapped coatings would be damaged in handling and where over-the-trench machines cannot satisfactorily negotiate. Somastic Pipe Coating is usually the best choice when such construction problems are encountered.

POLLUTION DANGERS

Pipe lines are occasionally run through watersheds or river valleys where it is essential that every precaution be taken to prevent leaks. Such locations are an excellent application of Somastic Pipe Coating both because of the protection the coating affords and the evidence given to public authorities and others that the best possible pipe protection is being used.

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News of Engineers

(*Continued from page 26*)

Robert D. James has been assigned as sales representative to the New Orleans office of Allis-Chalmers general machinery division. A graduate of North Carolina State, Mr. James recently completed the Allis-Chalmers training course for graduate engineers.

Albert P. Boysen, division engineer for the American Bridge Company, Chicago, took office as president of the Western Society of Engineers at the organization's annual dinner meeting in Chicago on June 7.

Walter K. Wilson, Jr., Brigadier General, U.S. Army, who has been serving as division engineer of the Mediterranean Division at Nouasseur, French Morocco, will return to the United States in August to the 18th Engineer Brigade, Fort Leonard Wood, Mo.

Charles V. Owen, formerly instructor in civil engineering at the University of Arkansas, has joined the field engineering staff of the Asphalt Institute. Mr. Owen has been assigned to Kansas and Nebraska as area engineer for work in connection with construction of the new asphalt pavement for the Kansas Turnpike.

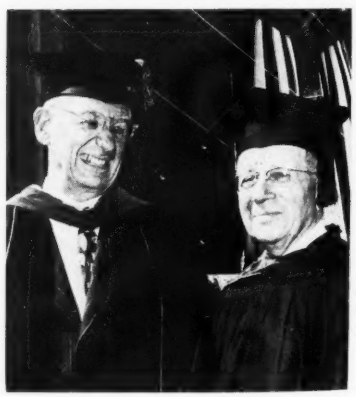
Michael A. Spronck, formerly executive field editor of *Construction Equipment* magazine, has joined the staff of D. B. Steinman, consulting engineer. Mr. Spronck is author of some 500 articles pertaining to engineering, public works, and heavy construction. He will serve as administrative assistant to Dr. Steinman.

George G. Meyerhof has been appointed professor of civil engineering and head of the Department of civil engineering at the Nova Scotia Technical College, Halifax, N.S. Until recently Dr. Meyerhof was senior technical assistant with the Foundation Co. of Canada at Montreal.

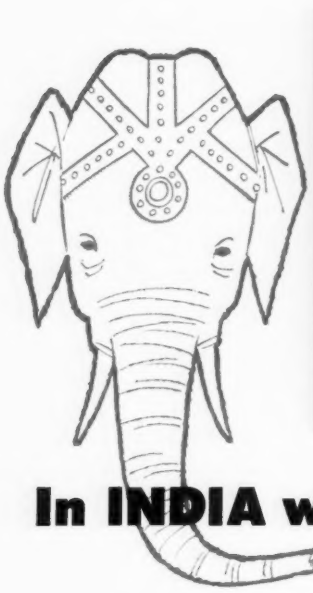
Daniel B. Ventres has been released to inactive duty in the Naval Reserve at his own request and has resumed duties with the Bureau of Reclamation in Washington, D.C. He has been on military furlough from the Bureau of Reclamation during a recent tour of duty with the Civil Engineer Corps, during the last portion of which he was chief of the Engineering Division, Joint Construction Agency, United States European Command, Paris. In the May issue it was incorrectly stated that Captain Ventres was retiring. He was recently elected vice-president of the National Capital Section.

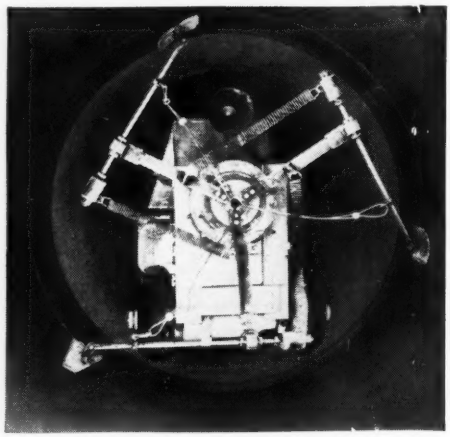
Frank B. Sarles has resigned his position as city engineer of Santa Rosa, Calif., to open an office for the general practice of engineering in the Bank of America Building, 217 Exchange Avenue, Santa Rosa.

Walter L. Huber (right), senior partner of Huber & Knapik, San Francisco, Calif., receives an honorary degree of L.L.D. from the University of California at its commencement excercises on June 17. He was one of three eminent scientists and



engineers honored. Mr. Huber had an important part in building the Central Valley Project in California, the Union Square Garage and the university's Medical Center in San Francisco. Mr. Huber was President of ASCE in 1953, capping a long career of service to the Society. Shown with him is Robert Gordon Sproul, president of the University.





In INDIA with CENTRILINE

On the coast of India, the Burma-Shell Refining Company has used the Centriline process on over 21,000 feet of sea-water cooling pipe. Through Centrilining, a cement-mortar lining is centrifugally sprayed on the pipe walls. Corrosion and tuberculation are eliminated . . . pumping costs are lowered . . . flow is increased . . . maintenance becomes negligible . . . and pipe life is extended indefinitely. This particular project in Bombay called for the Centrilining of 32" I.D. and 36" I.D. new steel pipe with 5/16" lining. But Centrilining works wonders in old pipes as well—with a minimum of surface traffic interruption. Proof of the pudding is in our files—the ever increasing number of repeat contracts from municipalities, industries and contractors. Why not follow their lead. Look to Centriline to rejuvenate *your* water supply systems.

Lummus Company, India, was engineer and constructor on this project. Asiatic Petroleum Corp. was buyer for the owner.

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Helmer A. Holmstrom, promoted in December from Lieutenant Colonel, U.S. Army, to Colonel, is now commanding officer of the Toul Engineer Depot, Toul, France. In February Colonel Holmstrom was assigned as commanding officer of the Advance Section's 313th Engineer Construction Group in Verdun, France, and previously was executive officer of the Chinon Engineer Depot, Chinon, France.

D. B. Steinman, consulting engineer of New York City, is the first recipient of the recently established International Grand Prize of Invention "for his inventive and scientific contributions and achievements in the design and construction of great bridges." The award was made in Paris by unanimous vote of the jury of the award. The Metal and Diploma of Award will be presented to Dr. Steinman in a special ceremony in New York.

Ralph B. Wiley was named "Engineer of the Year 1955 in Indiana" by the Indiana Society of Professional Engineers at the Society's banquet held May 14. Professor Wiley retired last June as head of the School of Civil Engineering and Engineering Mechanics at Purdue University where he had taught for forty-six years. Since then he has been consulting engineer for the Indiana Division of Mental Health. Professor Wiley has been director of the Joint Highway Research Project, a member of the Indiana Flood Control and Water Resources Commission, and chairman of the Indiana Stream Pollution Control Board. He is a former Director and Vice-President of the Society.

R. B. Wiley

William H. Hasselbach has been promoted from director of engineering for the Libbey-Owens Ford Glass Company, Toledo, Ohio, to vice-president in charge of engineering. He will be succeeded by **Roy A. Nyquist,** a company employee since 1934 and chief engineer since 1951. Also promoted in the expansion of the engineering department is **Russel W. Abbott,** former chief structural engineer, who has become associate director of engineering.

Bernard B. Gordon, formerly senior civil engineer with the East Bay Municipal Utility District, Oakland, Calif., has joined the staff of Porter, Urquhart, McCreary & O'Brien. In his new position he will be head of the West Coast Foundation Engineering Division which has offices in San Francisco, Sacramento and Los Angeles.

John W. Graham. Jr., since 1951 assistant dean of the College of Science and Engineering at Carnegie Institute of Technology, has been appointed dean of students. Dr. Graham joined the Carnegie faculty in 1946 after serving three years in the Army Corps of Engineers. He had the rank of major at the time of his discharge.

J. W. Graham, Jr.

Joseph M. Cooke has resigned as chief of the engineering division in the Huntington District of the Corps of Engineers, Huntington, W. Va., to become engineering chief for the Panama Canal Co., with headquarters at Balboa. Mr. Cooke has been with the Huntington District since 1934.

Ralph M. Leggette and **Maurice L. Brashears, Jr.,** announce a change in the name of their firm from Leggette & Brashears to Leggette, Brashears & Graham, Consulting Ground-Water Geologists with offices at 551 Fifth Ave., N.Y. Jack B. Graham, who has been with the firm for the past year, has been admitted to the partnership.

Frank J. Heger, Jr., has joined the Department of Civil and Sanitary Engineering at Massachusetts Institute of Technology as assistant professor of structural design. Recently Mr. Heger was assistant engineer with Ford, Bacon and Davis, Inc., New York. **Charles L. Miller,** assistant to the division engineer with Michael Baker, Jr., Inc., consulting engineer of Rochester, Pa., has been appointed assistant professor of surveying in the department.

Theodore E. Seelye has been elected president of Day & Zimmermann, Inc., Philadelphia. Mr. Seelye joined the company as a vice-president in 1933. Prior to that he had been engaged in engineering with other consulting firms, with the U. S. Government and in the U. S. Army.

Donald M. Baker, Los Angeles consulting engineer, has been named president of the University of California Engineering Alumni Society. Mr. Baker has been president of the California State Board of Registration for Civil Engineers, the Los Angeles Engineering Council, and the Los Angeles City Planning Commission, and was recently honored in a national competition conducted by the Urban Land Institute for a paper on means of lessening surface vehicular congestion in downtown areas.

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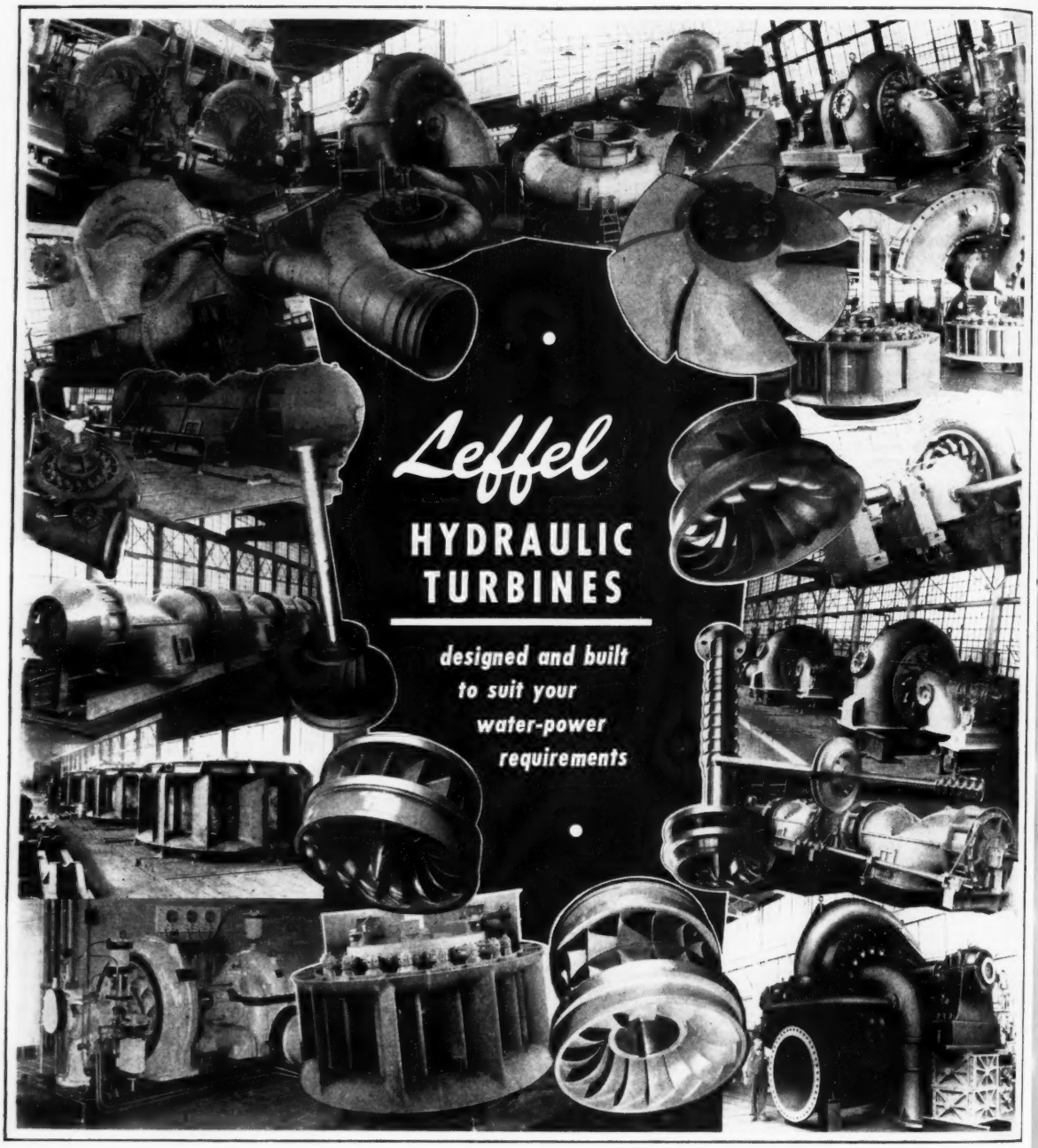

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Leffel hydraulic turbines are built to drive electric generators as well as many other types of machinery.

Many undeveloped, obsolete or inefficient water power installations can be profitably developed or modernized and rehabilitated by Leffel turbines.

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The construction boom is still gaining momentum? New construction activity is expected to reach $41.8 billion in 1955—11 percent above last year's record $37.6 billion, as the Departments of Commerce and Labor see it. Prospects are that both private and public construction will reach an all-time high, increasing by 14 percent and 3 percent, respectively.

Next year's President has been nominated? Vice-President Enoch R. Needles, of the New York City consulting firm of Howard, Needles, Tammen & Bergendoff, received the Presidential nomination for 1956 at the St. Louis meeting of the Board of Direction (page 75). Other actions taken by the Board are briefed on page 74.

Use of atomic waste for sewage treatment may prove feasible? Studies under way at the Army's Research and Development Laboratories at Fort Belvoir and at the Oak Ridge National Laboratory demonstrate that water-borne sewage can be sterilized by gamma radiation without leaving residual radiation in the treated liquids.

The first man-made radar island was recently "launched" at Quincy, Mass? One of thirty such defense installations that will be anchored to the continental shelf at strategic points along the coast, the 6,000-ton island is being towed to sea for location on Georges Bank, 100 miles east of Cape Cod. Each island, triangular in shape and 200 ft to a side, will be supported on three steel legs. When set in position 90 ft above low-water level, they will be clear of the highest waves. A crew of 70 will operate weather instruments as well as radar equipment for detecting aircraft.

Experts foresee a staggering increase in motor travel? Motor travel is expected to increase from 557 billion vehicle miles for 1954 to 814 billion vehicle miles by 1965. This sobering forecast was made by Karl M. Richards, secretary of the Highway Policy Committee of the Automobile Manufacturers Association, in a paper read at the St. Louis Convention.

Industry in the United States used nearly 380,000 tons of high explosives in 1953? The breakdown was 23 percent for construction projects, including seismic exploration; 30 percent for coal mining; 23 percent for non-metallic mining and quarrying; 22 percent for metal mining; and the remaining 2 percent for all other purposes. Source of these figures is the "Explosives Engineer."

"Civil Engineering" will be twenty-five years old in October? To mark this birthday we are planning an editorial bonus for readers in the form of a special issue.

Floating purification plants are being used in Iraq? To provide its population with pure water from rivers long notable for their pollution, Iraq is now using floating plants, which take in water from the river on which they float, treat it, and pump the purified water to nearby villages by pipeline. Manufactured by Britain's Marston Excelsior Ltd., the first full-scale plant designed for the country has a capacity of 2,400 gph.

There are new developments in the Engineering Societies Center situation? At its St. Louis Convention the ASCE Board of Direction decided in favor of further study of possible sites for the proposed center, and the ASME and AIME boards have taken somewhat similar action. These and other developments are summarized on page 75.

The economic feasibility of converting sea water into drinking water may be only a few years away? "Iron Age" magazine, in its special centennial issue, sees the widespread use of nuclear energy bringing about this and many other possibilities unimaginable a decade ago.

This is diamond jubilee year for several societies? The American Water Works Association, the U.S. Geological Survey, and of course the American Society of Mechanical Engineers are all observing their seventy-fifth anniversaries.

A colossal skyscraper may top New York's Penn Station? The New York real estate firm of Webb & Knapp has taken a one-year option and set up a unit to handle construction of a $100,000,000 "Palace of Progress" atop Pennsylvania Station. If carried out, the project will be a 500-ft-high skyscraper with 6,900,000 sq ft of floor area, the world's largest and costliest building.

Precast, Prestressed 'Incor' Concrete Warehouse

Left, interior of ultra-modern warehouse of Meyer Brothers Drug Co., New Orleans, with precast, prestressed girders and purlins, precast columns and roof slabs. Design live-load, 30 lbs. per sq. ft; column centers, 37′ x 33′. Above, completed warehouse, 187′ x 291′. Dependable 'Incor' high early strength speeded fabrication . . . frame erected in 18 working days.

ERECTED IN 18 DAYS

Here is prefabrication *plus* . . . that is, the important initial economies of precast, prestressed concrete design, *plus* the utmost fire-safety and lowest annual cost of quality concrete.

The 36-in. deep 'I' section girders and the 22-in. deep 'T' section purlins are precast, prestressed concrete; the 12″ x 12″ columns, lengths 10′ and 14′, and the lightweight, tongue-and-groove roof slabs, 3″ x 16″ x 7′4″, were all precast.

Cost in place of prestressed members and precast columns was 70 cents per sq. ft. Total cost of the 55,000 sq. ft. warehouse, $269,000.

Entire framework and roof slabs erected in 18 working days . . . result of factory-made members, produced to closest tolerances for rapid assembly, with minimum supervision.

Result, too, of high-speed, line-production in the pretensioning bed, made possible by the dependable high early strength of 'Incor'* 24-Hour Cement. Precast one day, prestressed the next . . . maximum production at minimum cost . . . hallmark of America's FIRST high early strength portland cement.

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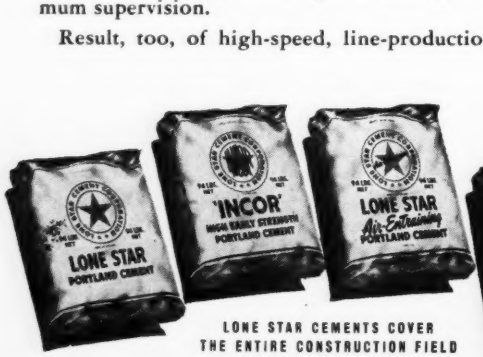

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Speed of construction is evident from two air photos. Inset was taken October 27, 1954, about six months before larger view. Starting at southwest corner, demolition progressed across site, closely followed by excavation, foundations, and steel erection. This was largest excavation operation ever contracted for in New York City.

NEW YORK COLISEUM

designed for fast construction

JACOB FELD, M. ASCE, Consulting Engineer, New York, N.Y.

An accelerated schedule and coordinated effort are producing a specialty building in minimum time—the New York Coliseum. The completion date is March 1, 1956, just 24 months after the preliminary layouts were agreed on. The work is now well advanced, on schedule, and being performed at costs below those in the original budget.

The present plan is the modified development of a series of studies and programs made from 1946 to 1954, to provide an exposition building in the vicinity of Columbus Circle, New York, N.Y. The original conception was for a combined sport and exposition palace, with auditorium for conventions and other public gatherings, covering the entire plot from 58th to 60th Streets, and Columbus Circle to Ninth Avenue, with 59th Street going through the building in a tunnel. But studies of possible revenue led to deletion of the sports use as competitive with existing space, and the assembly hall as being required only a few days each year. Furthermore, it became evident that the site could be obtained under the slum clearance act only if over half of it were used for new residential construction. The available land then became 49 percent of the original area.

Provision of garage space was required by the state act which enabled the Triborough Bridge and Tunnel Authority to finance and build the project. Both because of rock and ramp conditions, the garage was economically limited to two tiers below the street level, and the use of any street level or higher space for a garage was completely impossible. So there is provision for some 800 cars on a self-parking basis.

Exposition space in New York City is at present only available on a makeshift basis. The Coliseum will provide

four basic display levels with service and meeting rooms at mezzanine levels, so designed that each level can be completely isolated from any of the others. Exhibitions normally last one week but require a full week to set up and about a half week to dismantle, so that the space used is only about one-third efficient. By providing separate in and out traffic and loading facilities, the Coliseum will cut lost time about in half, so that each show will not be charged for over a week for both setup and removal. Since most exhibits try to get space for the spring and fall periods, the revenue picture will be much improved. The Coliseum should meet the urgent needs of New York for proper exposition facilities, convenient to hotels and central attractions, and will bring many conventions to the city. One of the areas has a 45-ft ceiling height, and access to all exhibit areas is provided for trucks of any size, to load and unload displays.

Utility connections will serve any location with drainage, hot and cold water, gas, compressed air and vacuum suction, 110-v lighting or 208-v a-c. Some areas are also wired for high-tension connections for X-ray and similar requirements, with telephone, teletype, radio and TV connections to both house and outside circuits. All spaces are fully air-conditioned and designed for an assumed population of almost 30,000 people when all areas are in use.

To provide enough fixed revenue to permit the financial investment, since the garage return cannot warrant that share of the cost, and the direct returns from exposition space are questionable, a 20-story office section was added. See Fig. 1.

The land area is 137,000 sq ft, approximately 421 × 339, with 59th Street deleted and both 58th Street and 60th Street widened from 60 to 80 ft.

The two-story garage covers the entire lot from the 58th Street curb line to the 60th Street curb line, with separate ramps from each street to each garage level, traffic routed in by signal lights to vacant spaces with no traffic crossing, and routed out so that every car passes a single control area and cashier.

The easterly part of the cellar contains all basic machinery rooms, transformer vaults, and subway connections to the Independent System express station and to a future IRT express station at 59th Street. Garage floor areas total 310,000 sq ft.

The street floor has separate lobbies and entrances to the office building, and to four possible expositions, all facing Columbus Circle. The corner under the office building will be occupied by a bank, the only commercial tenant. Along 58th Street are the main Coliseum elevator and ramp entrances. At the extreme west end is a ramp on a 12½-percent grade for any size truck or trailer to bring exhibits to the main exhibition floor, 22 ft above street level, with 20-ft vertical and 60-ft swing-around clearances. The trailer elevator has a capacity of 75,000 lb and a car platform 15 × 50 ft. It is a rotary lift of hydraulic type (using oil) and can take loads to any of the exhibit floors up to 62 ft above street level. There are two normal-size truck elevators of 20,000-lb capacity and two smaller freight elevators. All these elevators are connected by a levelator platform at street level so that trucks can load or unload at various tailboard heights. The Coliseum is also served by nine passenger elevators, some starting at the garage levels, and by seven tiers of escalators.

Exhibition space is all within a building 100 ft high, which covers the entire lot, including the space under the office building for a height of 75 ft. There is an expansion joint running east and west to separate that part on which the office building stands from the northerly part. There is a total of 400,000 sq ft of exhibition space, with 60,000 sq ft of storage and 16,000 sq ft of meeting rooms. The various levels and their exhibit areas are:

Street level, El. 0	69,000 sq ft
Main level, El. + 22	88,000 sq ft
Mezzanine level, El. + 44	71,000 sq ft
Upper level, El. + 63	45,500 sq ft

On the southerly end of the site there is a 20-story office building with the first floor 75 ft above street level, four spans wide for five stories and three spans wide above, providing 500,000 sq ft of rentable area from a total floor area of 680,000 sq ft, with 14 high-speed elevators and the necessary stairs and fire towers. To permit possible use for display of merchandise, all floors were designed for a 75-lb live load.

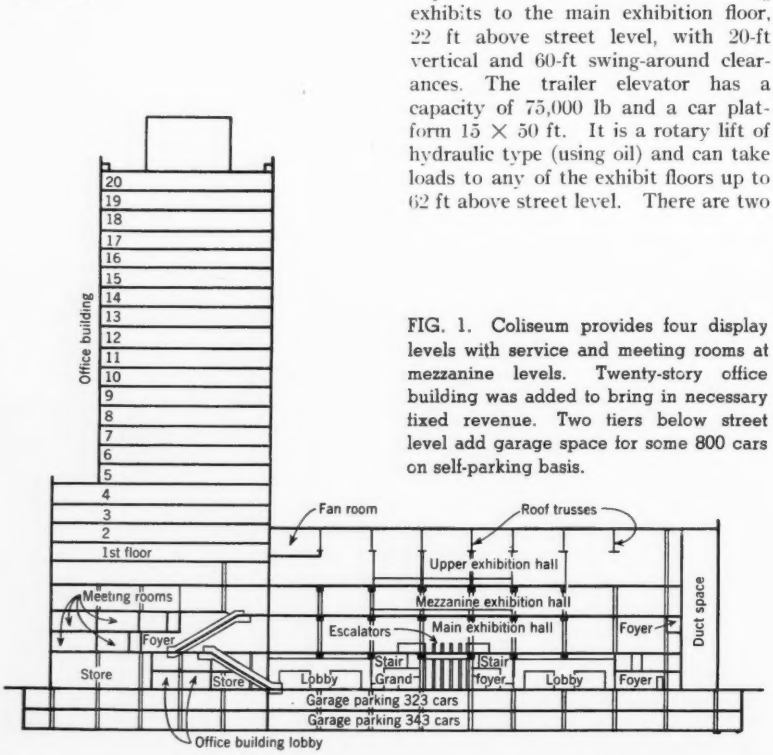


FIG. 1. Coliseum provides four display levels with service and meeting rooms at mezzanine levels. Twenty-story office building was added to bring in necessary fixed revenue. Two tiers below street level add garage space for some 800 cars on self-parking basis.

Column spacing and floor systems

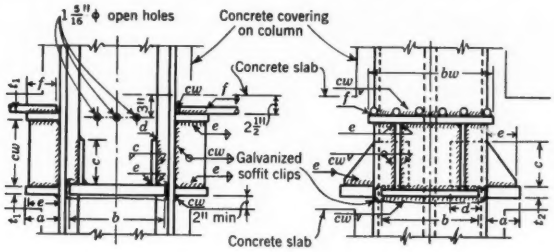
Column spacing was fixed by the average use requirements. To save headroom and keep the story height to a minimum, it was decided not to offset any columns. Exhibition space requires 6-ft multiples for booths; parking spaces are at 8-ft multiples with provision for columns, so a compromise spacing was necessary. The panels are 29 ft 3 in. × 26 ft 9 in. in the office building area and 29 ft 3 in. × 31 ft 6 in. in the rest.

This pattern is suited to the booth and passage layout for exhibitions and provides 9-ft car spaces with 22-ft clear aisles in the garage. The office layout was satisfactory, although normal office panels are considerably smaller. Live loads used to design floor systems were chosen so as not to restrict floor uses as follows:

Office floors, to permit merchandise display	75 psf
Lobbies, stairs, and meeting rooms	100 psf
Garage floor for private cars only	75 psf
Storage areas	200 psf
Secondary exhibition areas	200 psf
Main exhibition areas (street and 22-ft levels)	300 psf
Truck ramp and loading areas	300 psf

In addition, all floors were checked

FIG. 2. Critical design factor was shear at columns. Typically three rods pass through holes provided in column webs near top of slab, with steel brackets welded to column on four sides, to which top and bottom slab reinforcing steel is welded.



for truck concentrations where trucking was possible.

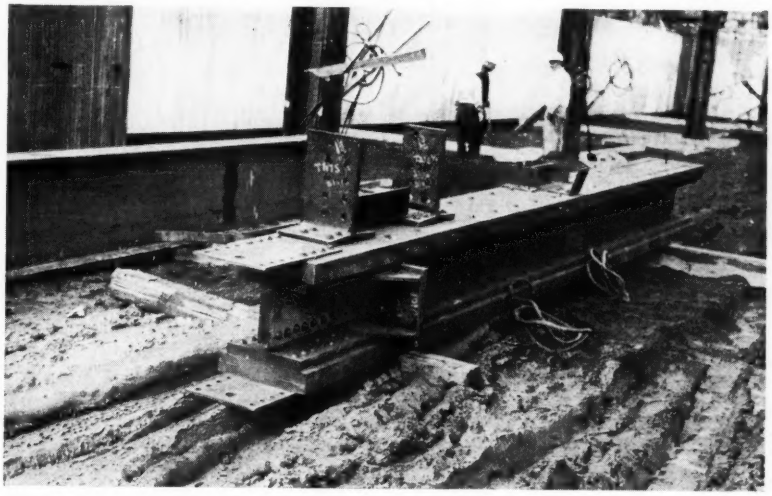
Various floor systems were studied for different parts of the building. The office building was designed both as a typical steel wind-braced frame with lightweight concrete slabs covered by fill and finish and also as a concrete flat plate with monolithic finish and steel-cored columns. Although cost estimates indicated a considerable saving in the latter design, flexibility in floor ducts and floor finish resulted in the choice of the former.

The main part of the building is a two-way flat concrete slab with steel-core columns, and with waffle domed ceiling to reduce dead weight. Except for square capitals on the columns below the street floor, there are no drops or capitals, and the floors are flat plates designed by moment distribution analysis Where spans are doubled in the exhibition areas, steel plate girders are used between columns, and the concrete slab is designed as a one-way span with the same pattern of domed recesses.

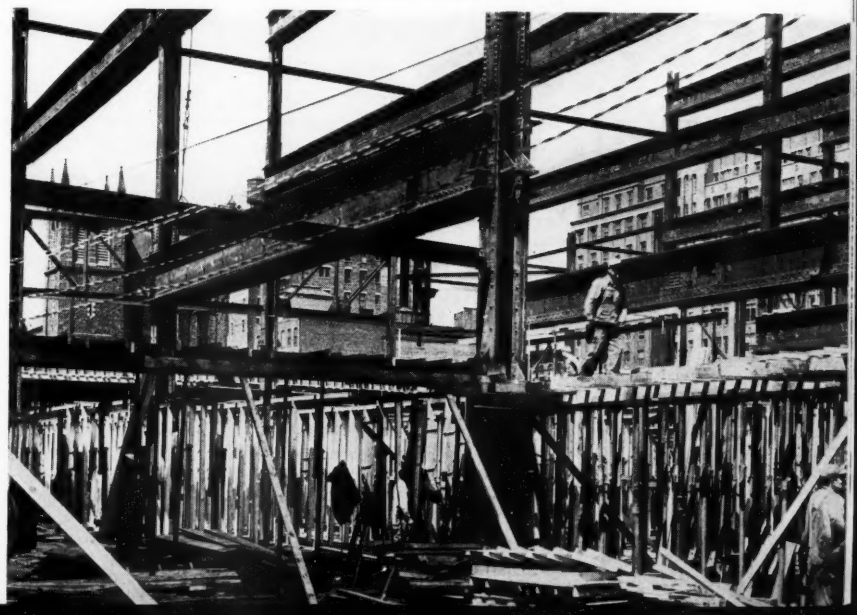
All ceilings outside the office area are exposed, with electrical and air conditioning distribution imbedded in the slab thickness. Typical domed forms are 19 × 19 × 8 in. high, spaced on 24-in. multiples. Where runs of ducts are imbedded, the domes are 4 in. high. Critical design factor was shear at the columns. Typically, three rods are passed through holes provided in the column webs near the top of the slab, with steel brackets welded on four sides to the column near the bottom of the slab. See Fig. 2. To provide maximum shear resistance, wire spider-web cages are placed around columns. Stirrups are placed in the ribs of floors with high live loads, with solid slab panels at all columns.

The south part of the building, separated by an expansion joint from the rest, is fully wind braced. The office tower is typically braced by all riveted girder connections using cropped beams at flanges for moment, and side-angle or T-connections on the web for shear. In the levels below, moments are developed by welding the slab bars to plates shop-welded to the columns. A typical connection required 6 to 8 large bars to be welded on each side of

Magnitude of building loads is evidenced by size of built-up columns, one of which is shown in photo below. This section weighs 22 tons.



Lower section of falsework for concrete floor is seen in place. On top of this goes second, adjustable section reaching up to next floor level (indicated by shear connectors on center column). Double plate girder across exhibition area is seen at upper center.



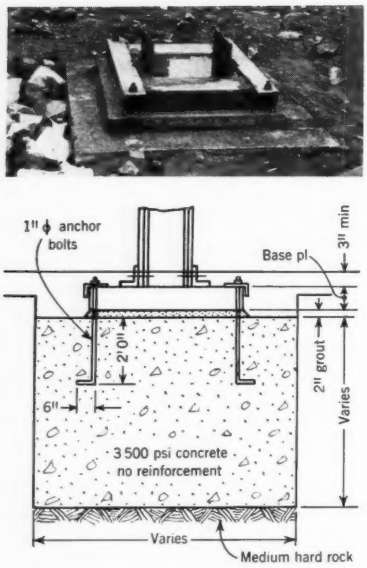


FIG. 3. To avoid getting anchor bolts in wrong position, detail was developed for holding down base plates with angles lapped over two edges rather than by passing bolts through plates. This permitted foundation work to progress before plans for superstructure were completed.

the column, and the detail was found satisfactory in the field. All welds were field inspected.

Main roof over the Coliseum consists of steel trusses up to 130 ft in span, some the full story height to support fan and machinery rooms. Typical riveted trusses were used with T-section top and bottom chords. Original designs were for welded trusses with pipe sections for all web members, but the steel contractor requested a change in design. The roof is poured gypsum concrete on steel purlins, providing light weight and some insulation.

A lower-level steel truss frames the opening over the main truck ramp, a span of about 93 ft and a full story in height. This truss was erected on columns and had to be free standing until adjacent steel was erected. For some reason only known to the public relations personnel of the contractors, the erection of this truss was widely publicized in the press and television as an unusual engineering feat. The steel company even showed the pictures in their annual report to the stockholders. The publicity was most favorable, but entirely unwarranted. There is nothing unusual in this truss.

Concrete for foundations and all structural concrete is a controlled mix of 3,500 psi; concrete walls and unreinforced floors on grade are 2,500-psi mix, with trap rock specified as the coarse aggregate for all floor slabs in exposition and trucking areas. Cement for all superstructure concrete is specified to be Type II A, with no restriction on the type for foundation work. Air content has been found to fluctuate somewhat, apparently very sensitive to humidity and temperature conditions, being highest when barometer readings are lowest. All test cylinders are weighed immediately upon filling the molds and in this way immediate warning of unusual low weights is obtained. Low-weight cylinders are found to give lower strengths. In addition to the required four cylinders per 100 cu yd of concrete for the 28-day test, two cylinders are made for a 7-day test. The mix for 3,500 psi is:

Type II A cement	675 lb
North Shore sand	1,150 lb
New York traprock, $^3/_4$-in. size	1,940 lb
Water	37.5 gal per cu yd
Average slump	$2^1/_2$ to 4 in.
Average 7-day strengths	2,200 to 3,500 psi
Average 28-day strengths	3,700 to 4,500 psi

Concrete for the office tower floors will contain a lightweight aggregate to produce a 3,000-psi mix with a maximum density of 108 lb per cu ft.

Office building floors will be cement finish on 2 in. of lightweight fill. Service, garage and ramp slabs are cement monolithic finished with integral hardener. Lobby and toilet-room floors will be terrazzo. Exposition floors are of unusual detail; the concrete is hand screeded and then rotary screed finished after seeding the surface with a dry mix of $^3/_8$-in. trap rock and cement. After proper aging, these floors will be ground to a smooth and level surface, exposing polished faces of the aggregate. This finish was chosen to: (1) permit use of the floor slabs during construction, (2) give a hard surface, (3) eliminate the dusting which would result from a steel trowel finish, (4) provide some color and texture variation.

Demolition and substructure

Work started in March 1954, and the demolition contract required removal of a number of buildings, including some 6-story tenements and a theater, in 3 months to clear Sects. 1, 2 and 3 (all but the northeast quadrant). A 27-story steel-frame office building partly covering Sect. 4 (northeast quadrant), possession of which was not obtained until June 1, 1954, was demolished in 5 months, an unprecedented speed. This is the tallest building ever demolished.

Excavation followed as closely behind demolition as safety permitted, and the excavation surrounded the substructure of the office building almost the same day the demolition was completed. Removal of earth and rock to specified levels, each item being about 75,000 cu yd, together with the excavation of all pits and trenches, was performed in nine months.

This is the largest excavating operation for one building ever contracted within the city. Rock was found to be above subgrade over almost the entire area. Chiefly mica schist, the seams ran in a great variety of directions and breakage was blocky. By forming faces away from adjacent buildings, using milli-second delayed-action exploders, and covering all blasts with wire-rope mats, there was no damage and practically no complaints from the entire operation. Even glass breakage was held to the unheard-of minimum of one pane of glass, and that one in the excavation contractor's field office.

All footing pits were carried down to sound rock. Only in four pits was unsatisfactory rock found at required depths, three of them in a rift or wide seam of soft rock and one in a circular pocket of extremely soft material surrounded completely by hard rock. In addition to trenches for drainage pipe, deep trenches were cut for a system of concrete pipe vents placed below the cellar floor to provide the required air changes for both garage levels. These reinforced concrete pipes varied from 24 in. to double 84 in., and with the tops all level, the subgrades formed trenches also used to drain all ground water towards the sumps, located in the northeast quadrant. The pipes were backfilled with gravel so as to act as french drains for permanent drainage of ground water. This method of ventilation saved the space for exposed ducts in both garages and saved considerable depth of construction since these ducts would have added over 3 ft to each story height to provide the required clearances.

All column footings are plain concrete of 3,500-psi mix. The size was fixed by the code requirement that the area be three times the size of the base plate if the maximum base pressure of $37^1/_2$ percent of the strength (1,312.5 psi) is used. This restricted the rock pressures to 32 tons per sq ft. Some 8,000 cu yd of concrete was used in footings, pit walls, and cellar walls. Using Type I cement, not a single test cylinder gave results below the 3,500 requirement. The mix was:

Type I cement	613 lb
Metropolitan sand	1,305 lb
Broken stone	1,900 lb
Water (average)	39.0 gal per cu yd
Slump	2 to 4 in.

Because so much of the excavation and foundations were completed before plans for the superstructure were finished, and to avoid getting anchor

bolts in the wrong place, a detail was developed for holding down the base plates with angles lapped over two edges rather than by passing the bolts through the plates (Fig. 3).

Structural steel

Loads in the columns under the office building run up to 6,000 kips and in the Coliseum area up to 3,600 kips. For these loads, comparative designs of grillage and base plates showed that the latter was more economical as an overall picture, totaling cost of steel, concrete, and rock excavation. Base plates range in thickness from 3 to almost 12 in. and are all set on cement grout. Only the top strip directly below the column is milled. Column base angles are welded to the plates. Structural steel totals about 13,000 tons. Below El. 162 (ground floor level = El. 100), except for steel girders surrounding the elevator and escalator shafts, the steel consists chiefly of column cores. With the base plates, they total 5,300 tons. The weight of the members is best indicated by the fact that there were only 3.5 field rivets per ton of steel erected. Where sizes permitted, columns were shipped in four-story lengths, as long as the weight was less than 30 tons. Some of the lower columns weighed almost one ton per foot and consisted of double 14 H 320 with 34 × $2^1/_2$ plates, and plates on the webs as well.

All steel columns supporting concrete flat-slab or beam reactions have welded brackets at each floor level to transmit shears directly into the steel core. The concrete encasement was considered merely as fireproofing. Because of an omission when the New York City Code was revised to permit higher column stresses when designed as structural steel, the composite concrete-steel column for the higher loads requires larger steel sections than the steel columns. The steel core in a composite column is still restricted to the lower values of the older code. All columns were required to be not over 20 in. in total depth in a north and south direction so that the maximum fireproofed dimension is 24 in.

In addition to the welded shear brackets where wind moments are carried into a column, plates are also provided at the level of the top reinforcement, welded to the column, to which top bars are welded to develop the required moments. All columns in wind braced areas are faced with webs in the direction of the wind bents.

To brace the free-standing columns until concrete decks are completed, two tiers of steel brace beams are temporarily connected in tower arrangement, and removed just before the deck level just below is formed. The bracing levels are approximately 44 and 88 ft above the base plates. The roof and penthouse supports over the Coliseum, mostly trusses and purlins, total about 1,500 tons, and the office tower makes up 6,000 tons, about $17^1/_2$ lb per sq ft. The steel erection schedule was so tight that shop details were prepared by two separate detail contractors, and fabrication was also divided between the Pottstown and Bethlehem shops of Bethlehem Steel Co. All steel goes to ground storage in Jersey City for sorting and shipping to the site only as required.

As a continuation of 59th Street, a ramp was constructed directly into the excavation, over which all steel for the entire area was delivered up to El. 162. The other streets are too narrow to permit steel trucks to make a turn into the lot. Erection sequence followed foundation construction quite closely, all steel being erected by crawler cranes, usually directly after pickup from trucks. The office tower is being erected by three guyed derricks, one of which was set on sills in an elevator shaft at street level so that it would be available for setting the other derricks. Steel erection of the office building tower was held up until all concrete slabs in the southerly quadrants were completed below the first office-floor level.

In the Coliseum section there are three levels of double plate girders to span the 58-ft and 63-ft open areas. Some of these are three-span continuous girders resting on top of columns under the open areas for the upper exhibition floors. All other girders are connected by webs to the flanges of columns in direct shear. Roof trusses are of conventional design, using split beam T's for chords and double angles or T's for web members. Where additional gussets are required for joint connections, plates are butt welded to the webs of the T's.

The only steel to be painted is the members not encased in concrete. All field connections in the wind-braced office building section are riveted; rivet sizes are 1 and $1^1/_8$ in. Field connections in the Coliseum are also riveted, except that the roof-truss bracing and upper structures will be bolted, using high-strength steel bolts for column connections and truss bracing. Shop and field inspection of the fabrication and erection is under the control of the designing engineers.

Concrete—500 to 900 cu yd per day

All substructure concrete came from the Transit Mix Company. Superstructure concrete comes from the 54th Street and Hudson River plant of the Colonial Sand and Gravel Company. Although trap rock was specified only for concrete in the exposition floor areas, the vendor elected to use the same aggregate for all concrete to avoid possible delays and eliminate separate stockpiles. Plant and field control of all aggregates, batching, mixing and placing is divided so that the contractors are responsible for the materials until they arrive at the site, and thereafter the designing engineers have full responsibility and control.

With concrete use averaging about 500 cu yd per day, and a maximum of 900 on a few days, four full-time inspectors have to work considerable overtime to check and control concrete delivery and placing in addition to placement of reinforcing. Formwork is very simple. Open grids of planks are laid to provide support for steel pans, 24 in. square formed to 19 × 19-in. domes, 8 in. high. The lips of the domes fit tight, and a single large-headed nail is driven at each corner intersection. All beams, adjustment strips, and solid panels at columns are formed with plywood.

All reinforcing is delivered to a rented parking lot immediately west of the project. Bending of bars, in accordance with local requirements, is done at the site, and completed bundles of cut and bent bars are lifted by crane to the form level. Reinforcing is supported by preformed metal chairs, with cadmium plated legs. Welding of bars to connecting plates on columns is done by wire lathers. Close inspection has indicated satisfactory results.

Where shears are high in the concrete ribs, thin wire stirrups are used. Around columns, where shear stresses exceed 100 psi, welded diagonal cages are assembled in two concentric squares. Reinforcing details follow the ACI detail standards. All rods are high-bond type, intermediate-grade billet steel. Concrete is delivered in 7-cu yd transit-mix trucks, mixed at the site and hoisted to distributing hoppers at the levels being concreted. Power-driven buggies, of 12-cu ft capacity, distribute the mix to the forms. Placing is accompanied by constant vibration.

In each of the exhibition floors, slabs are full of utilities and facilities. Metal ducts for high-velocity air for heating and cooling connect into expansion chambers imbedded in the ceiling and taking up four domed panels. In addition there are 3 × 4-in. metal ducts for telephone and TV cables; 3 × 7-in. metal ducts for water, gas, vacuum, and other service connections with floor plates for attachment to exhibits, and with vertical stacks at columns. There are also electric conduits for light and power, coming from subpanels at column

locations. Add to all this, the drains, water risers and vents, also concentrated near columns, and the extent of the study required to coordinate sleeves and necessary structural modifications at each column at each level can be pictured.

Through joint study by a three-man committee, representing the structural, mechanical and architectural phases, a solution was arrived at for each problem. In some locations, a dropped concrete panel was necessary, placed within the limits of the masonry partition enclosure of the service connection closets. In most locations, the mechanical requirements could be redistributed to avoid overstress at the column perimeter.

Fast construction schedule

Hardly had preliminary plans been started when it was decided to let a construction contract on the basis of a fee and guaranteed maximum cost and start construction before the plans were completed. A total time schedule of 24 months was set up, and the architects agreed to prepare information in the order needed. The general schedule was to push demolition in the south quadrants and then alternate the subsequent items of work between the south and north areas. The time schedule was generally set up by the contractors in consultation with the architects and engineers during a luncheon meeting in March 1954, to permit completion of the Coliseum by March 1, 1956, and of the office building one month later. Now, with over half the time gone, that schedule is still being followed and seems likely to be met.

Only very close cooperation between the various offices doing the planning, and also with the contractor's representatives, kept the various construction trades supplied with the necessary data and materials for going ahead. The inevitable arguments, although sometimes noisy, were not too serious. As soon as the field offices were set up with space allotted to each subcontractor as well as to the supervisory and inspection staffs, weekly meetings were held to check on the status of plans, details, materials, and performance as they affect the schedule.

Performance to date has involved the alternate placing of each trade in sequence, first on the south half and then on the north. Excavation pushed demolition to completion and the steel erector pushed the foundations to completion, even forcing a supplementary agreement whereby the bottom of the office building was removed by the excavator. Steel erection has progressed in stages covering, first, the south half to El. 162, then the north half to the same level while the concrete floors are being placed in the south half. As soon as this work is done, erection of steel in the office building continues, and concrete operations are concentrated in the north half. Meanwhile all mechanical trades are running lines below each completed concrete deck, and masons are enclosing the south half and placing interior partitions.

Stairs are concrete below the street floor and are constructed with the floors. Upper stairs are steel and are being set up with plank threads to serve as a vertical connection between floors. Elevator work is well advanced so that temporary service to El. 162 will be available before the office tower work requires many workmen.

Subsequent to the preparation of my paper but before its presentation, on May 9, 1955, a large section of formwork at El. 122 in Section 4, fell while concrete was being placed. Of some 550 cu yd placed that day, almost 500 cu yd fell, and some 20 minutes later, adjacent areas of formwork in various stages of preparation also fell into and towards the previous collapse. Of some 60 men immediately on and under the affected form areas, one was killed and several received serious injuries.

The exact cause of the failure is still under investigation. Visual inspection and full-scale load tests (300 psf and a 20-ton truck) indicate that the floor below, which took the impact loading of the fall, was not damaged. Clean-up has been completed and concreting in this area was continued on June 15, 1955. The lost time, in the affected area only, will be made up by overtime and increased labor. Work on the south sections has not been affected.

Estimated upset cost of the entire work is $33 million, with the major items as follows:

Item	Cost in Thousands	Contractor
Demolition	$ 600	Wreckers & Excavators, Inc.
Excavation and foundations	1,500	Thos. Crimmins Contracting Co.
Structural steel	3,500	Bethlehem Steel Co.
Structural concrete	5,000	Brennan & Sloan, Inc. and Knickerbaker Constr. Corp.
Elevators and escalators	2,500	Watson, Burwack, Otis and Westinghouse
Heating, plumbing and air conditioning	6,000	Almirall & Co. (heating), Astrove Plumbing Co. (plumbing)
Electrical work	5,000	T. Frederick Jackson, Inc. and J. Livingston & Co.
Masonry and interior work	7,000	John B. Kelly, Inc. (masonry) and others

Responsibility for construction of the New York Coliseum rests with the Triborough Bridge and Tunnel Authority, Hon. Robert Moses, Chairman, and George E. Spargo, M.ASCE, General Manager. In direct charge of this project is Arthur S. Hodgkiss, M.ASCE, as Assistant General Manager; J. F. Vermaelen as Director of Construction; and William Wilson, M.ASCE, as Special Coordinator. The general contract is held as a joint venture of the Walsh Construction Co., George A. Fuller Co., and Slattery Contracting Co., Inc.

Architects for the Coliseum are Leon and Lionel Levy, with Eggers & Higgins, Aymar Embury II, and John B. Peterkin as consultants. Design and supervision of mechanical and electrical work are by Guy Panero Associates, Consulting Engineers. Design and supervision of the foundation and structural work are by Jacob Feld, M.ASCE, Consulting Engineer. All the above are of New York, N.Y.

(This article is based on the paper presented by Mr. Feld before the meeting of ASCE's Metropolitan Section on May 18, 1955.)

Large section of formwork for floor at El. 122 fell on May 9, 1955, while concrete was being placed. Of some 550 cu yd placed that day, 500 cu yd fell. Exact cause of failure is still under investigation. Several workmen were seriously injured; one was killed.

OUR INTERSTATE HIGHWAY SYSTEM—

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Design standards for the Interstate Highway System were discussed by Mr. Barnett in a paper presented at the ASCE St. Louis Convention, before the Highway Division session presided over by Emmett H. Karrer, Vice Chairman of the Division's Executive Committee. For purposes of publication, Mr. Barnett's paper has been divided into two parts, the first of which is printed here. The second part—to cover control of access, accident experience, engineering personnel, standardization and esthetics—will appear next month.

I. New design standards related to traffic needs

The National System of Interstate Highways is generally thought to have had its beginning in the report[1] of the National Interregional Highway Committee, appointed by the President on April 14, 1941. This committee made its final report on the 1st of January 1944, and the Congress, in the 1944 Federal Highway Act, Sec. 7, called for the designation of a National System of Interstate Highways not exceeding 40,000 miles in total extent, so located as to connect by routes as direct as possible the principal metropolitan areas, cities, and industrial centers, to serve the national defense, and to connect at border points with routes of continental importance in Canada and Mexico. The selection was to be made by the state highway departments, subject to the approval of the Secretary of Commerce.

The writer likes to think that the real beginning of the Interstate Highway System was much earlier, in the middle '30s, when it was realized that facts concerning highway needs were lacking and the statewide planning surveys were established in the state highway departments. From these planning surveys emerged the concept of relating the development of our highway system to the needs of traffic as determined factually. These factual data were examined and the need for an Interstate Highway System was first described in 1939 in the report, "Toll Roads and Free Roads."[2] The appointment of the Interregional Highway Committee followed.

Changes in design

The ideas which evolved from the highway planning surveys and other investigations of the states, counties, and cities resulted in profound changes in highway design not only for the interstate system but for all highways. The dominant change in the past decade or two has been that a conscious effort has been made to relate design to traffic needs as determined by factual surveys and analysis. This may seem a strange statement to those who have designed highways for two decades or so, but not if it is recalled that, in the early days of highway development, little of the design practice was based on established facts. Highway engineers by and large did a remarkable job of design considering the lack of information regarding the needs and behavior of traffic.

Engineers had a good sense of the economics of highway transportation and located highways to get the shortest distance between controls, commensurate with cost and balancing cuts and fills. Speed was considered, and curves were related to it in a general way by insuring that no curves would be sharper than the maximum computed by a formula relating speed, centripetal acceleration for the curvature, and superelevation. Tangents were favored but rarely was a curve

No fixed minimum width of right-of-way is specified. Wide widths have many advantages, but narrow widths may sometimes be necessary. And a constant width is not desirable. This highway, like that shown on preceding page, meets interstate design standards.

transitioned, nor was any attempt made to examine the effect of any succession of curves on traffic behavior.

Gradients depended entirely on topography. A maximum grade was adopted to result in the lowest cost, and its effect on vehicle operation was recognized to some extent, principally in correction for horizontal curvature. Vehicle operation, if considered at all, was considered on an individual basis. Early highway engineers had little information on the action of vehicles en masse. Estimates of capacity, if they were made at all, were based on theoretical assumptions, now found to be incorrect under most conditions.

The effects of the physical appearance of the highway on driver behavior were considered little, if at all. Vertical elements along the traveled way, such as abutments, piers, and signposts, were given sufficient lateral clearance to physically clear any vehicle overhang but the effect on lateral placement of vehicles was almost unknown. Surfaces were designed for skid resistance and with high crowns for drainage.

In the past 10 or 15 years there has been a vast amount of research that has firmly established factual guides on such matters as driver behavior, both individually and en masse, grade ability of trucks, lateral placement, acceleration and deceleration, driver ability and vehicle ability for various types of maneuvers. And there has been a searching inquiry into the causes of accidents. In this short period of time valuable documents on these subjects have been published by the Highway Research Board and the American Association of State Highway Officials, particularly the Highway Capacity Manual,[3] and the rational approaches to design embodied in the Geometric Design Policies.[4] These have been supplemented by the manuals and standards of the several state highway departments that have studied the needs of traffic in their respective states in relation to their local ability to provide highways to satisfy these needs.

Modern highway design also takes advantage of continuing improvements in materials, construction techniques, and equipment. Unit cost of grading, for example, has advanced little above the average for 1925–1929, whereas the advance in cost of structures, using a similar base figure, has been about 127 percent, and that in cost of surfacing about 66 percent. The low cost of grading has made it possible for designers to greatly improve the cross section and profile to better serve traffic needs. Heavy cuts and fills can be justified, and there is less need for balancing them.

Increasing knowledge of soils has made soft ground lose its terror, and the time necessary to decrease moisture content and settle fills has been reduced from years to months. Also it has been realized that the base and subgrade act in combination with the surfacing to support highway loads. Drainage and hydraulic information in relation to highways has also advanced so that drainage facilities, which constitute such a large percentage of highway cost, are more economically designed and there are fewer failures due to storms and floods. An overall advance in design has resulted from the conscious effort to minimize cost of maintenance. From this has come about the streamlined cross section, the elevation of roads above groundwater during the spring thaw, and numerous changes in materials and processes to reduce deterioration of the physical plant.

Bridge design also has gone through many changes due to improvements in materials and techniques but probably the biggest change has been in thinking. Formerly a bridge was located first to fit the physical conditions at the site, and the highway was designed to reach the bridge regardless, almost, of the alignment required. Now however, the bridge designer is called upon to fit his structure into the overall alignment and profile of the highway. Even large bridges are no longer designed on the assumption that approaches are a secondary consideration, particularly in and near urban areas. The bridge has taken its rightful place as part of the transportation artery.

The National System of Interstate Highways is the most important system of roads on a national basis. With only 1.2 percent of the total road mileage, it carries about 15 percent of all traffic, joins nearly all cities over 100,000 population and over half of the cities with 5,000 or more population, serves 58 percent of the population, passes through most of the productive areas of the country, and is the most important network from the standpoint of national defense. It follows that the highest standards commensurate with traffic needs should be used in its design. While the interstate system includes some of the most important roads in the country, it also includes in some sections roads which, on the basis of traffic volume and local significance, are of less importance than main roads in other sections not on the interstate system. Except for the fact that interstate highways constitute links in a national system and are given priority due to their importance for long-distance transportation and the national defense, their design should not be materially different from that of any other road carrying a comparable volume and kind of traffic. The standards and procedures used in the design of interstate highways, therefore, could very well be applied to all arterial highways.

First and foremost in the design of any road, and particularly roads on the interstate system, is the determination of the "loads" to be carried. The principal load is that of traffic. It is generally agreed that this load should be the traffic, in both kind and volume, to be expected 20 years beyond the completion date. This is the standard adopted by the American Association of State Highway Officials. It is not within the bounds of this article to describe the methods of assigning present traffic to a proposed facility, and the procedures and factors used in expanding such traffic and combining it with generated traffic and development traffic to predict what traffic will exist in 20 years. There is a vast literature on this subject and it is discussed in Chapter II of the AASHO Geometric Design Policy.[4]

Traffic volume varies over the hours of the day, days of the week, and sea-

sons of the year. It is wasteful to design for the expected maximum, and all highways can, with some inconvenience, accommodate volumes greater than their design capacity. There is general agreement that the volume for which highways should be designed is the 30th highest hourly volume of the year for which the design is made. There are some exceptions, of course, such as roads of a highly seasonal nature, but the 30th highest hourly volume, adopted some years ago, has held up very well. Hereafter, the 30th highest hourly volume is referred to as the DHV, design hourly volume, followed by the applicable year, a number indicating the years after completion, as DHV-current, DHV-10, and DHV-20. Also, average daily traffic is referred to as ADT, with the applicable year.

Chapter II of the Geometric Design Policy[4] also gives the dimensional characteristics of vehicles which should be used in design. For interstate highways there may be a need for adjustment to accommodate military vehicles, but by and large highways designed for the dimensions of the largest design vehicle described will accommodate nearly all military vehicles.

The same chapter also discusses design speed and its relation to running speed. The AASHO has adopted three speeds for interstate highways, 70, 60, and 50 miles per hour (mph), and has called for geometric controls directly related to design speed. Curvature, superelevation, sight distance, and allied features such as transition curves, should be designed in accordance with the Geometric Design Policy. For average conditions and volumes of traffic, the design speeds correspond to average running speeds of 49, 45, and 40 mph, respectively. Under favorable conditions and light volumes it is possible to drive with reasonable safety at about 85, 73, and 62 mph on roads designed for 70, 60, and 50 mph respectively.

With knowledge of the three load factors, the geometric design can proceed with reasonable assurance that it will fit traffic needs. The three load factors are: (1) traffic volume and the distribution of volumes through the various hours of the year, (2) kinds of vehicles, particularly the percentage of trucks, and (3) design speed.

AASHO Geometric Design Standards

Starting with these factors it is well to review the Geometric Design Standards for the National System of Interstate Highways prepared by the Committee on Planning and Design Policies of the AASHO and now being considered by the AASHO. In these standards the traffic basis for design is the same as in the preceding paragraphs but recognition is given to the need for criteria for initial construction which may be a stage of the final design by calling for initial construction to accommodate traffic expected only 10 years after completion. Also, the standards call for deferring only those parts of the ultimate design which can readily be added at a later date and with a minimum of interference with traffic. Deferrals should not be allowed for geometric design features such as alignment, profile, and right-of-way, or for control of access. At a later date traffic lanes or even separate roadways can readily be added, provided undercrossings are wide enough to accommodate them; pavements can be strengthened; overcrossings can be widened and entire grade separations and interchanges provided. But inadequate alignment, grade, and sight distance, when once molded into the landscape and tied down, are most difficult and expensive to correct. Moreover the acquisition of additional right-of-way and rights for access control may become prohibitive in cost, and indeed impossible of acquisition when businesses are developed along the highway.

TABLE I. Current traffic volumes justifying initial grade separations

	Any one combination may apply		
When interstate highway traffic is	DHV, 600 or more	DHV, 400 or more	DHV, 400 or less
and crossroad traffic is	ADT, 50 or more	DHV, 200 or more	DHV, 300 or more

DHV = 30th highest hourly volume; ADT = average daily traffic

The standards call for ultimate elimination of all railroad grade crossings. Initially all railroad crossings, including sidings, are to be eliminated on all highways of six or more lanes. On all other highways separations are to be provided initially at crossings with two or more main-line tracks and at crossings with one main-line track where the DHV-current is 200 or more or the DHV-20 is 400 or more. Appropriate protective devices are called for at all railroad grade crossings. High-speed trains increase the accident potential at grade crossings. This factor is accounted for in the standards by reference to main-line tracks, but designers might well consider eliminating any railroad grade crossing on an interstate highway where there is even one daily train traveling 60 mph or faster.

Except for some interstate highways in sparsely settled rural areas, the standards call for ultimate elimination of all highway grade crossings, and acquiring or reserving the right-of-way for the separations initially. Where there is deferral of some of the features of the ultimate design, grade separations are to be provided initially or the crossing road terminated, rerouted, or intercepted by frontage roads, where the current traffic volumes on the interstate highway and on the crossroad are as given in Table I.

Under the criteria in Table I, crossings at grade are permitted initially where the cross traffic is less than 50 vehicles per day. This is not in keeping with the concept of free-flowing, controlled-access highways, and most states are likely to ignore this criterion. Crossings at grade are particularly undesirable in and near municipalities and where the interstate volume is high, but in such locations the likelihood of crossroads with a traffic of less than 50 vehicles per day is small. The redeeming feature is the requirement for acquiring the right-of-way for future separations at once so that they can be provided readily when accident or delay experience proves they are needed.

The standards call for traffic lanes at least 12 ft wide, designing for a divided highway where the DHV-20 exceeds 800, and providing a divided highway initially where the DHV-10 exceeds 600. These are, in effect, the values below which a two-lane road may be provided. (It may come as a surprise to some that there will be a considerable mileage of two-lane roads on the interstate system.) These design volumes are high for any two-lane road, and are very high for roads as important as those on the interstate system. A DHV of 800 corresponds in most rural areas to an ADT of 5,000 or 6,000, and a peak day of about 10,000 or more vehicles.

While such volumes are within the possible capacity, they can be accommodated only with a type of operation that is not acceptable to most drivers, since one cannot pass but must stay in line even where the sight distance is adequate for passing. Such values, surely, should not be used in design, and most states are likely to adopt lower values as a design control.

Fortunately the standards, in addition to calling for a divided highway where the DHV-20 exceeds 800, call for a divided highway when it exceeds a lower two-lane design capacity applicable to the conditions on a particular section. This, in effect, calls for two-lane highways to be designed with sufficient sight distance for safe passing to accommodate the design hourly volume. This is a concept that may be

unfamiliar to many designers. The capacity of a two-lane highway can vary greatly depending on the ability to safely pass a slower-moving vehicle. A two-lane highway with a sight distance sufficient to pass at all points has a capacity considerably greater than that of a similar two-lane highway on which the sight distance sufficient to pass is encountered on, say, 50 percent of its length. The kind of topography and the percentage of trucks are material factors. Table II gives capacities taking these factors into account.

The capacity of two-lane highways can be increased by providing greater opportunities for passing. This can be done by conscious attention in design to providing as much as feasible of the length of the highway with a sight distance sufficient for passing and providing a third lane on the upgrade side, a climbing lane, for trucks where critical lengths of grade are exceeded. There is excellent compliance on the part of truckers in the use of climbing lanes. Their design, relating gradient, length, speed, volume and percentage of trucks, is given in the AASHO Policy on Geometric Design.[4]

Gradient is so closely related to topography that the preparation of a standard on a national basis is difficult. The standards call for gradients no steeper than 3, 4, or 5 percent for design speeds of 70, 60, and 50 mph, respectively, but permit gradients 1 percent steeper in rugged terrain and up to 2 percent steeper under unusual conditions.

Traffic lanes 12 ft wide are widely accepted for all highways of importance, but what sometimes is not fully understood is the need to insure that the full lane width is usable by avoiding the use at the edges of any vertical or near-vertical element such as a barrier curb. Lateral vehicle placement studies clearly show that vertical elements reduce the width of the traveled way. The standards call for barrier curbs, where used on the right, to be offset at least 2 ft, and walls and abutments to be offset at least 6 ft. The writer fails to see the value of a curb on the right of a through traffic lane, even in urban areas where it is often used. Shoulders have proved their worth, not only in satisfying the needs and desires of road users for a place to stop clear of through traffic, but as a safety factor. Shoulders are particularly valuable in urban areas where, during peak flow, one vehicle stopping on an outer through lane not only delays vehicles in its own lane but on all lanes, and can cause complete stoppage.

Curbs, even sloping curbs, are a deterrent to the use of the shoulder. The argument for such curbs as an aid in drainage control, formerly considered sound, is no longer valid. The tests of the Western Association of State Highway Officials at Malad, Idaho, rather startlingly demonstrated the value of paved shoulders in preserving the load-carrying capacity of the subgrade. With the shoulder paved, any curb necessary for drainage control can be better placed at the outer edge of the shoulder than at the edge of the through traffic lane.

With paved shoulders an interesting problem arises. The shoulder should be kept free of moving traffic so that it is available for stopping vehicles. Yet a smoothly paved shoulder is likely to attract traffic, particularly where it is of the same color and texture as the through traffic lane. On high-volume roads, as in urban areas, a stream of moving traffic on a shoulder can destroy its effectiveness as a refuge and cause the same delays and stoppages as on any other road without a shoulder. On low-volume roads a paved shoulder encourages slow-moving traffic to use it. Such traffic is likely to consist of heavy trucks which habitually keep to the right, and their use of the shoulder can cause its early destruction.

One solution is sharp contrast in color and texture between shoulder and through-traffic lane but this is not always practicable with bituminous pavements. The writer suggests that shoulder surfaces be waved, or that a series of ridges or jiggle bars be placed on them. The bars can be located with their nearest ends 2 or 3 ft from the edge of the through traffic lane; they need not be more than an inch in height; and they can be spaced 30 ft or so apart. As an experiment, 2-in. by 4-in. strips of wood can be nailed onto the shoulder. These strips or jiggle bars will not deter the stopping vehicle from using the shoulder, but it is not likely to be used more than once by a continuously moving vehicle, so that a stream of moving traffic will not develop.

The standards call for a shoulder with a usable width of at least 8 ft, defining usable width as that from the edge of the through traffic lane to the meeting of shoulder slope and ditch or side slope, when the latter is 1 on 4 or flatter, and to the beginning of rounding when it is steeper. The standards, incidentally, call for 1 on 4 side slopes where feasible in the interest of safety, and limit slopes to 1 on 2 except in rock excavation or other special conditions. With the trend toward greater width in passenger vehicles and the pressure for an increase in the maximum allowable width to 102 in., 8 ft is not an adequate width of shoulder. A width of 10 to 12 ft is more realistic for the interstate system.

On divided highways there should be a space equivalent to a shoulder on the left of traffic although this is not called for in the standards. The need for space for emergency use to avoid accidents and for paving to preserve the bearing power of the subgrade is as great on the left as on the right. While some 6- and 8-lane highways can justify shoulders for stopping on the left, the practice is not likely to become widespread. The shoulder on the left, therefore, need not be as wide as that on the right. A left-surfaced width of 3 to 6 ft is suggested. On the left also curbs are a deterrent and should be avoided except on narrow medians, where a barrier curb may be necessary to prevent crossing of the median as at initial direct entrances. Where barrier curbs are used in narrow medians they should be offset from the edge of the through traffic lane. Since the steering wheel is at the left of the vehicle, a curb on the left does not affect lateral vehicle placement as much as a curb on the right. The standards, therefore, call for a minimum offset of only one foot. The standards also call for $3\frac{1}{2}$ ft as the minimum left offset for higher vertical elements, and $4\frac{1}{2}$ ft for abutments, walls, and piers.

The standards call for medians at least 20 ft wide in rural areas and 16 ft in urban areas, and permit narrow medians down to 4 ft in urban areas of high right-of-way cost, on long and costly bridges, and in mountainous terrain. The standards also call for widening narrow medians to at least 16 ft at such grade crossings as are provided initially. The 16-ft figure is, frankly, the minimum median width which enables the designer to provide a median lane for direct left turns at grade crossings.

TABLE II. Design capacity of two-lane, two-way highways

(12-ft traffic lanes, adequate shoulders, access control)

Percentage of highway length with sight distance eye-to-road less than 1,500 ft		Design Capacity, vehicles per hour		
		Percentage of Trucks		
		0%	10%	20%
Level terrain	0	900	780	690
	20	860	750	660
	40	800	700	620
Rolling terrain	0	900	650	500
	40	800	570	450
	60	720	510	400
	80	620	440	350

TABLE III. Suggested minimum widths of right-of-way, in ft

Type of Highway	Without Frontage Roads	With Frontage Roads
2-lane	120	220
4-lane divided	150	250
6-lane divided	175	275
8-lane divided	200	300

There is little to fire the imagination in the minimum width of median strips being considered by the AASHO, and no state desiring to construct interstate highways to high standards is likely to use such narrow widths except at critical locations. Such widths make it difficult to provide the center drainage so necessary in areas of high rainfall or where freezing and thawing make it desirable to place a crown at the center of each roadway. In snow areas, narrow medians provide little space for snow storage and in all areas they not only fail to reduce the effects of headlight glare but make it difficult, yet necessary, to provide and maintain costly headlight screens. A narrow width minimizes the favorable safety factor of a median and often makes it necessary to provide costly and undesirable curbs to prevent vehicles from crossing it.

A narrow median also makes it impossible to borrow from the median for widening pavements when traffic increases beyond the capacity of the original design. Where medians are of adequate width and piers or other supports at undercrossings are kept well back, additional lanes can be added in the median at little extra cost, with a minimum of change in the roadsides and other facilities and with little interference with traffic.

The designer cannot skimp on medians and expect to produce a pleasing, economical, and safe highway. He should not provide a narrow median strip of constant width. The best solution is two separate one-way roadways as discussed later.

No fixed minimum width of right-of-way is given in the standards since the right-of-way must be at least wide enough to accommodate the necessary cross section elements, including medians, pavements, shoulders, outer separations, ramps, frontage roads, slopes or walls, and border areas. Fixed widths are not given because it is recognized that wide widths have many advantages, narrow widths may sometimes be necessary, and a constant width is not desirable. The minimum widths given in Table III, however, are suggested as guides for rural areas. These values recognize the greater widths required for frontage roads where control of access cannot otherwise be provided.

No standards have yet been adopted for the design of the combined surface course, base course, and subgrade because there appears, as yet, to be no unclassified material giving the types, sizes, and weights of military vehicles which should be included with the traffic to be used in design, and it is feasible, economical, and the practice in many states to build up surface courses by stage construction as traffic increases. It is the writer's opinion that the combined surface course, base course, and subgrade should be designed to provide adequate support for the type and volume of traffic, including military vehicles, expected within 20 years.

Initial construction should provide adequate support for the type and volume of traffic expected within 10 years following completion. The supporting ability should be at least that required to support maximum axle loads and total weights permitted by current state law or the maximum recommended by the current Policy on Motor Vehicle Sizes and Weights[5] of the American Association of State Highway Officials, whichever is the greater. The maximum axle load recommended in this policy is 18,000 lb and the maximum load permitted by dual axles is 32,000 lb where the distance between axles is 40 in. or more. The maximum load permitted by any group of axles is determined by the formula,

$$W = 1{,}025\ (L + 24) - 3L^2$$

where W = weight in pounds, and L = distance in feet between the extreme axles of the group.

The intensity of single-axle loading and the frequency of such loads are the principal factors in the structural design of surface courses, base courses, and subgrades in combination. The group axle loadings are the principal factors in the structural design of bridges, except that single-axle loading or a group of two axles is the principal factor in the design of bridge floor systems and short-span bridges. Lack of information on military vehicles handicaps designers of bridges but the matter is being considered by the Committee on Bridges of the American Association of State Highway Officials based on studies of the Bridge Branch of the Bureau of Public Roads, made at the request of the Department of Defense. The committee is expected to issue structural standards for the design of bridges on the interstate system. The task was not completed at the time of this writing. It can be revealed that except for short spans a bridge designed for the AASHO Standard Specifications for Highway Bridges,[6] using H20-S16-44 loading, will, with reasonable overstress, accommodate military wheeled vehicles at all speeds, and military track vehicles at reduced speeds. The design of floor systems and main members for short-span bridges will require a slight modification to provide for somewhat greater axle loads than the single 32,000-lb axle called for in the H20-S16 loading.

The Geometric Standards for Interstate Highways cover clearances for bridges as well as highways. For bridges they are not much different from the AASHO Specifications for Highway Bridges. On bridges up to 100 ft in length between abutments or end supporting piers, the full roadway width, including usable width of shoulders, is to be carried across the structure. On longer bridges barrier curbs and curbs on approaches, if used, are to be offset from the edge of the through traffic lane at least 2 ft and the offset to parapet or face of rail on both right and left is to be at least $3\frac{1}{2}$ ft. The value of shoulders to enable vehicles to stop outside the through traffic lanes is recognized by calling for emergency stopping places on long bridges carrying heavy volumes. Minimum vertical clearance is to be 14 ft over the full width, including usable width of shoulder, and allowance should be made for any contemplated resurfacing. On interstate routes in rural areas remote from alternate routes, the standards call for 15-ft minimum vertical clearance.

The geometric standards call for all culverts to be of sufficient length to carry the pavements, median, and shoulders across without reduction in width, but the drainage factors were left for future determination by the Bridge Committee, AASHO. The writer suggests that all culverts and bridges over streams and approach highways in combination be designed to accommodate floods at least as great as those of 50-year frequency, with the runoff based on the adjacent land development expected 20 years hence. All other drainage facilities, such as gutters, ditches, inlets, and local drainage systems, should be designed to keep the traveled ways usable during the severest storm of a 10-year frequency. The research and design procedures developed in recent years enable these determinations to be made by anyone familiar with the fundamental laws of hydraulics and hydrology.

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Disposal of radioactive wastes—

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The fact that safe and adequate disposal of waste products from all of man's activities is becoming increasingly important is, I am sure, well known to all engineers. One has only to consult the popular press to become acutely aware of the militant interest of the public in matters directly concerned with waste disposal and environmental sanitation. The increasing legal and legislative activity in this field is further evidence of the concern of the public and its agencies.

It is timely to discuss this subject because competitive industry is showing increased interest in the use of atomic energy. Government-directed programs to date have been largely concerned with weapons, research, and development. Passage of the Atomic Energy Act of 1954 and expansion of the industry in commerical channels will surely lead to a wider use of radioactive and fissionable material outside of special, security-controlled project areas, and this use is likely to be nearer centers of population.

If nuclear energy is to find its place in a competitive economy along with other industries it must be used where it can serve people, their communities and their industries. So the people will need to have a better understanding of the atomic energy industry and its products. As this new industry becomes an integral part of community structure, public officials who supervise industrial operations will find it essential to be better informed as to the operation the advantages and disadvantages, of atomic energy.

Properties of atomic energy wastes

Radioactivity is the most important, and indeed the unique, property of wastes in the nuclear energy industry. Radioactivity may be considered as a form of contamination, although its characteristics are markedly different from those of other contaminants such as organic matter, biologic growths, or chemical compounds. In certain products or environments they may be objectionable or even harmful. Radioactivity is not readily detectable by the human senses or by ordinary analytical techniques applied to other industrial wastes. With proper instrumentation, however, radioactivity at significant levels can be measured accurately. These and other characteristics make radioactivity an insidious as well as a hazardous contaminant. Its use places more than average responsibility on the user.

Radioactive materials give off particles or radiations which are potentially dangerous to life and property if the levels of activity are high or exposure is prolonged. Permissible levels of radioactivity in water we drink or air we breathe have been established based on long and short-term exposure.

Another property of radioactive material is that it gives off energy over a specific length of time. This may range from seconds to centuries; and for a specific radioisotope the characteristics of the radiation and the period of radioactivity are fixed by nature and cannot be changed by any practical means. Rarely do wastes from other industries continue to maintain their original characteristics over an extended period of time.

Time does not permit detailed discussion of other interesting and significant properties of radioactivity. Those cited are sufficient to demonstrate to anyone who deals with radioactive materials as contaminants that he must understand their properties and have knowledge of the nomenclature, tolerances, and techniques used in working with nuclear energy.

Sources of wastes

To proceed in an orderly manner, let us first examine the sources and origins of these radioactive wastes or contaminants. Wastes are evolved in all phases of the nuclear energy industry from mining and processing of ores, through feed material processing, fission reaction in nuclear reactors, and chemical processing of irradiated fuels. For all practical purposes, one might say, the liquid wastes resulting from the last-named step constitute the bulk of the problem since they contain by far the greatest quantity of radioactivity. Although in the main this is true, it should however be pointed out that high-volume, low-level wastes such as those emanating from contaminated laundry operations or laboratories handling relatively small quanti-

Need for quantitative information on dilution factors in streams is being met by investigation on Mohawk River in vicinity of Knolls Atomic Power Laboratory. Here the *Catamaran* is engaged in radioactive tracer run on that river. This work is being carried out by U.S. Geological Survey with General Electric Co., AEC Schenectady Operations Office, N.Y. State Department of Health, and Harvard University.

a growing problem

U.S. Atomic Energy Commission, Washington, D.C.

ties of radioactive materials, must also be considered since, under certain conditions, they are more susceptible to direct discharge to nature.

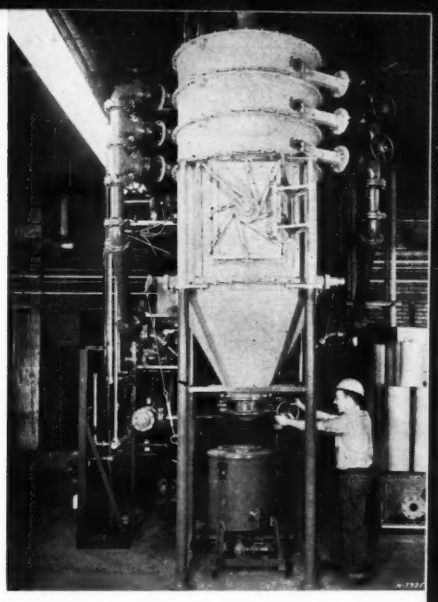
Nuclear reactors. In a nuclear reactor, high levels of radiation are established. Here fissionable material is introduced as fuel and a continuous chain reaction is maintained by the neutrons which are emitted. Since material exposed to neutrons becomes radioactive, all material leaving a reactor is under very strict control.

If a reactor is air cooled it requires large volumes of air to carry away the heat produced in nuclear fission. There will be some irradiation of the constituents of the air on exposure to neutrons If the intake air is not filtered, or if, in flowing through ducts to the reactor, the air picks up dusts of various kinds, any particles in the air would become radioactive in the reactor and contaminate the effluent air stream. For this reason the sizes and locations of air intakes are carefully selected. The incoming air is filtered and provision is made to prevent dusts in air passageways or ducts. The degree to which gaseous effluents from an air-cooled reactor are hazardous depends on the level of activity which exists, the length of time the irradiated material will be active, the radiotoxicity of the material to living tissue, and the extent to which the effluent becomes diluted in nature after release.

Usually release through a high stack serving a reactor or a chemical separations plant will permit natural dilution to a safe level, but in the selection of stack height several factors must be considered. Important among them are: (1) the distance to persons who might be exposed; (2) the cost of the stack, which varies with its height; (3) the frequency of favorable and unfavorable meteorological conditions; and (4) feasibility of periodic shutdowns as against continuous operation of the facility. A satisfactory decision calls for an integrated judgment by the meteorologist, the health physicist, the owner and operator. At the reactor of the Brookhaven National Laboratory on Long Island, the stack of the air-cooled reactor is over 300 ft above grade. The volume of air flow for cooling the reactor is about 300,000 cfm.

In the case of a water-cooled reactor, as at the Hanford Works in the State of Washington, the irradiated coolant water creates a special problem in disposal. Here the water passes through the reactor and eventually is discharged to the Columbia River. As in the case of the air-cooled reactors, very large volumes of coolant are used. For process purposes and in order to reduce the problem of radioactivity in disposal of the effluent, the coolant water obtained from the Columbia River is treated to a high degree to reduce dissolved and suspended material to low levels. Many of the radioisotopes in the effluent have short half lives. Therefore, by holding this water in basins for a few hours before releasing it to the Columbia River, a substantial amount of radioactive decay takes place. When the released cooling water is diluted with the river flow, the radioactivity at downstream points of use is below established permissible limits for drinking water.

In the water-cooled reactor of the recirculating type, the practice is to demineralize the water so that when it is subjected to neutron bombardment in the reactor the levels of radioactivity will be low. Some slight pick-up in dissolved or suspended solids does occur, however, and this is offset by continuous bleed-off, decontamination, and return of a small percentage of this recirculated water. Decontamination is usually by ion exchange units. When the radioactivity of the exchange media becomes too high for safety, the media



Prototype incinerator BOMAEC-100 is being developed by U.S. Bureau of Mines to handle radioactive combustible waste. Nominal capacity is 100 lb per hr, and special feature is use of high-velocity tangential over-fire air. Photo courtesy of Bureau of Mines, U.S. Department of the Interior.

Fixation of radioactivity on montmorillonite clay is being studied at Brookhaven National Laboratory. Work, now in pilot-plant stage, involves clay extrusion in columns (middle photo). Purpose is to permit hydraulic passage of waste liquid through column. Trayful of extruded montmorillonite clay is seen at right.

TABLE I. Basic radioisotope data

Isotope	Half-life	Grams per Curie	Body Tissue Affected	Max. Permissible Concentration	
				Microcuries per cc	ppm
U^{235}	4.5×10^9 yrs	2.9×10^6	Bone	8×10^{-5}	232
Ra^{226}	1.6×10^3 yrs	1	Bone	4×10^{-8}	4×10^{-8}
Cs^{137}	33 years	3.8×10^{-2}	Muscle	1.5×10^{-3}	5.7×10^{-5}
Sr^{90}	25 years	6.1×10^{-3}	Bone	8×10^{-7}	4.9×10^{-9}
Sr^{89}	53 days	3.6×10^{-5}	Bone	7×10^{-5}	2.5×10^{-9}
p^{32}	14 days	3.4×10^{-6}	Bone	2×10^{-4}	6.8×10^{-10}
I^{131}	8 days	7.8×10^{-6}	Thyroid	3×10^{-5}	2.3×10^{-10}
Na^{24}	15 hours	1.1×10^{-7}	Total body	8×10^{-3}	8.8×10^{-10}

are disposed of by burial in a selected disposal area.

Chemical processing From the standpoint of actual disposal of wastes, the chemical processing wastes are, as indicated, the major problem. Although considerable progress has been and is being made, much work has yet to be done before we can say the problem is solved.

Chemical processing of reactor fuels is done to separate unfissioned or unburned fuel from the desired product and the wastes. Generally speaking, this means separating uranium, plutonium and fission products. The fission products which constitute the "hot" component of the wastes are radioactive elements ranging in mass number from 70 to 162. From an environmental standpoint, the more troublesome of these elements include strontium, cesium, and others in the rare earth series. In the solid fuel slug prior to separation (which is today generally a wet chemical process), the concentration of fission products ranges from 100 to perhaps 1,000 ppm.

In the course of processing the fission product, concentration is considerably diluted by solvents, water, and other solids. The resulting streams of liquid wastes are therefore quite dilute as far as mass concentration of fission products is concerned. However, because of the intense radioactivity of these elements, these wastes may contain quantities of radioactivity up to several hundred curies per gallon. In addition, the effective half life of this radioactivity may be measured in hundreds of years. These wastes also may generate heat to the extent of 1 to 3 Btu per gal per hour. Depending on the characteristics of the fuel elements and the processing system, the wastes may also contain high concentrations of inert salts.

Waste handling and disposal

At present these high-level wastes are stored in undergound tanks (as differentiated from ultimate disposal) at a cost ranging from $0.30 to $2.00 per gal of tank capacity alone. In an effort both to reduce costs and to find methods that more closely approach the criterion of ultimate safe disposal, intensive development work is being carried out. One phase of this work involves the development of special treatment systems. An example of this is the work being done at the Brookhaven National Laboratory on the fixation of radioactivity on montmorillonite clay. At Brookhaven National Laboratory it has been found that by heating, up to about 800 deg C, the clay that has absorbed radioactivity, it is possible to fix the activity so that it cannot be leached out by water or even strong acids. This "hot" clay can then be buried in a location that is otherwise adequate for ultimate disposal. The work at Brookhaven is now in the pilot-plant stage.

Another phase of the work that is gaining impetus at the present time involves evaluation of the capabilities of nature to safely receive these high-level wastes. An important part of this latter phase is being accomplished at the Johns Hopkins University, where members of the Sanitary Engineering Department are developing information on the feasibility of safely disposing of radioactive wastes to the oceans or into various deep geologic structures.

Another part of our waste disposal development program is being carried out at Harvard University. There a group is investigating the capabilities of surface waterways to receive safely wastes of certain low and intermediate levels. The Harvard group is also working actively with representatives of the U.S. Geological Survey, the New York State Department of Health, and the Knolls Atomic Power Laboratory in a field study of dilution factors in the Mohawk River below the Knolls Atomic Power Laboratory. Already three tracer runs have been conducted in which as much as 5 curies of radioactivity have been injected into the river through the Knolls Atomic Power Laboratory outfall. Since the water supply intake of the City of Cohoes is 13 miles downstream, the significance of such tests is evident. Preliminary results indicate that, under the test conditions, in less than 5,000 ft of travel downstream the radioactivity concentration is reduced by natural means to around background level.

This introduces a proposal for waste disposal which has occupied our attention over the past few months. The proposal, which is for application to AEC operations, is the joint effort of the sanitary engineering group, the biophysics group in the Division of Biology and Medicine, and others with a direct interest in our waste disposal operations. This matter has been discussed with a group representing the U.S. Public Health Service, the American Water Works Association, the Conference of State Sanitary Engineers, ASCE, APHA, AIHA and FDA. At the present time, staff of the AEC is incorporating this material into health and safety regulations being promulgated as implementation for the Atomic Energy Act of 1954.

The essential point in this proposal for nuclear energy waste disposal operations that is of primary interest to the sanitary engineer is, in effect:

> The maximum quantity of radioactivity that can be discharged from a nuclear energy plant will be such that the concentration of radioactivity at a water-supply intake will not exceed one-tenth the permissible levels, as given in Handbook 52 of the National Committee on Radiation Protection.

Where a stream is not used as a source of water supply, factors such as the nature of stream uses, the duration of such uses, and the various physical characteristics of stream flow, must be taken into account.

This proposal clearly shows the importance of quantitative information regarding dilution factors in streams and the need for research and development work, such as that being done at Harvard and on the Mohawk River.

Other considerations bearing on radioactive wastes and water supplies that may have been previously brought to the attention of sanitary engineers warrant some emphasis here. First—and this is a real ameliorating factor in connection with radioactive wastes—these wastes, unlike bacterial or infectious wastes, do not have the same degree of "one-shot" ability to produce damage. In the case of typhoid or gastro-intestinal infection, for example, a single exposure, as is well known, can be very serious. The fact that this is not necessarily so with radioactive materials may be illustrated by comparing maximum permissible levels for a mixture of isotopes whose specific components are unknown for different periods of time.

Exposure Time	Max. Permissible Concentration Microcuries per cc of water
Lifetime	1×10^{-7}
30 days	1×10^{-3}
10 days	3.5×10^{-3}

For interest only, it may be noted that the Pluto Spring at French Lick, Ind., contains radioactivity to the extent of 4.9×10^{-7} microcuries per cc, and the spring at Nauheim Glen, N.Y., has 2.6×10^{-5} microcuries per cc. Secondly, we have found that the suspended and bed load, and the natural turbidities in water have a distinct capacity for taking up and absorbing radioactivity. This may be characterized loosely as an active self-purification factor.

Tolerance considerations

Since reference has been made to maximum permissible concentrations, it is appropriate to list in convenient form certain basic radioisotope data. The data given in Table I in the last column will orient us in terms with which we are probably more familiar.

It is obvious that, compared to allowable concentrations of other substances with which we are familiar, we are working with, to put it mildly, rather small quantities on a weight basis. Nevertheless, as previously noted, with proper instrumentation (and only in this way), concentrations of radioactivity of the order of magnitude noted can be detected fairly readily.

Perhaps it would be of interest to interpret these maximum permissible concentration figures a little further by seeing what degree of radioactivity removal would be required in a domestic water supply if in the raw water there was a radioactivity concentration, say, of 1 microcurie per cc. In the unlikely event that the radioactivity was solely Sr^{90}, a removal efficiency of 99.99992 percent would be required to meet the lifetime maximum permissible concentration previously noted. To meet the one-day criterion, a removal efficiency of 99.9 percent would be necessary. For P^{32} the corresponding treatment efficiencies required would be 99.98 and 50 percent respectively. Although this is strictly a hypothetical case, it does serve to bring out the time-permissible exposure relationship which is important in considering radioactivity as a water supply contaminant.

Other research and development

Some of the research and development projects connected with waste disposal problems have been noted briefly. At the present time rather heavy emphasis is being given to evaluation of the feasibility of, and problems associated with, the disposal of high-level wastes to surface and underground geologic formations.

It should be noted here that in this business of waste disposal we have had the active cooperation of the Geological Survey for a number of years.

At Oak Ridge National Laboratory, field experiments are being carried out on the disposal of high-level wastes in surface pits. In these experiments the capacity of the natural earth materials (Conesauga shale) to take up and retain radioactivity is being investigated. Other important parts of the work include detailed hydrologic and geologic studies relating to waste movement, the development of impermeable membranes for pit liners, and investigation of thermal heat dissipation.

Arrangements were recently completed with the Earth Sciences Division of the National Academy of Sciences, National Research Council, to assist us in the general attack on the overall problem of ground disposal. In a very preliminary way mention has been made of the possible feasibility of disposal into salt domes or salt strata, hydrologic basins or troughs, and into coastal formations on the salt water side of the salt water–fresh water interface. Obviously, there are many questions to be answered before it can be said that any particular system is feasible.

At the present time it is believed that the possibilities of disposal of high-level wastes at sea are behind those envisioned for land disposal. The primary reasons for this are: (1) the general lack of quantitative data on pertinent oceanographic factors; and (2) the high costs and complex technical problems involved in preparing, handling, and transporting high-level wastes to what might be a suitable disposal point at sea. Nevertheless, here too the assistance of experts in the field of oceanography and allied disciplines is being enlisted to enable us to arrive at an engineering conclusion with regard to the question of sea disposal of these high-level wastes.

Considerations for the future

In an industry such as ours which is about to emerge as a commercial, competitive endeavor, it is perhaps somewhat foolhardy to speculate on future events. It is generally agreed that nuclear energy as a peaceful force holds great promise for the future of man. Now let us briefly examine what one piece of the future industry might mean to us in the field of waste disposal.

In a recent paper before the American Power Conference in Chicago, our Director of Reactor Development, W Kenneth Davis, estimated that by 1965 we would have in this country some 5,000,000 kw of nuclear power capability. Similarly for 1970 he extimates 27,000,000 kw; for 1975, 83,000,000 kw; and in 1980, 25 years hence, 175,000,000 kw. At present time installed generating capacity in the United States is given at 100,000,000 kw and the doubling time has been estimated at 15 years.

Now when 1 gram of uranium is fissioned, 24,000 kwhr (1 megawatt day) as heat energy is produced and about 1 gram of fission products is formed. One year after removal from a continuously operating reactor this 1 gram of fission products would be equivalent to about 1 watt of heat power. Using the 1965 figure above:

$$5{,}000 \text{ electric megawatts} \times 365/0.30 = 6.1 \times 10^6 \text{ heat megawatt days per year}$$

That is, from the nuclear power industry in 1965 we would expect 6.1×10^6 grams of fission products which at 1 year of age would have a heat power level of 6.1×10^6 watts. Since 1 watt is equivalent to 500 curies, we arrive at a total quantity of activity in 1965 of 3×10^9 curies. By 1980 this figure would increase to 1.05×10^{11} curies per year. This latter amount for comparison purposes is roughly twice the quantity of all the radioactivity in the oceans of the earth. One can calculate, using the figures previously given, and the 5.3 percent fission yield for Sr^{90}, that for the 1980 rate of fission-product production it would require something like 2×10^{18} gal of water to dilute the Sr^{90} to safe drinking levels. It is apparent that the uncontrolled discharge of such wastes to our environment would not be tolerable or practical. It is emphasized that these calculations are based on certain assumptions which may not be absolutely correct: nevertheless an "order-of-magnitude" picture is possible.

In conclusion, it appears reasonable to state that the waste disposal problems associated with an expanding nuclear energy industry represent an important and integral part of any consideration of the industry's development. To date the problems have been adequately met, but when one views the future potentialities of the industry, it is obvious that safe, more efficient and economical ultimate disposal of radioactive wastes is one of the major challenges to the industry as it progresses. In this progress, and as part of a team, the sanitary engineer has an important part.

(This paper was originally presented before the April 20 meeting of the Metropolitan Section of ASCE in New York.)

Louisiana's first tunnel built in open cofferdam

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Civil Engineer, R. P. Farnsworth & Co., Inc.

New Orleans, La.

Middle section of Belle Chasse Vehicular Tunnel is constructed in sheetpile cofferdam, shown in top photo. Cofferdam consists of MZ-38 sections driven in 60-ft lengths with their tops paralleling roadway grade. Cofferdam is 470 ft long and 45 ft wide. In photo at right, tunnel nears completion. Intracoastal Waterway, which will pass over it, also nears completion, except across through highway No. 31 at right, which of course must be kept open until tunnel is ready to take traffic.

The first tunnel to be constructed in Louisiana is now nearing completion at Belle Chasse, a small community 8 miles southeast of the center of the city of New Orleans. This tunnel, a public project being constructed by the Louisiana Department of Highways, will carry vehicular traffic on State Highway No. 31 under the Intracoastal Waterway. See Fig. 1. That portion of the waterway under which the tunnel is to pass, is at present under construction and has not been excavated. Therefore waterborne traffic is no problem. Highway 31 carries all the vehicular traffic from New Orleans down the west bank of the Mississippi to the delta at the mouth of the river.

There will be two traffic lanes in the tunnel, each 11 ft 0 in. wide, and one pedestrian walkway 5 ft 0 in. wide located over the air duct. The tunnel consists of a single tube of reinforced concrete 800 ft long and two approach ramps each 567 ft long.

To avoid rerouting the existing highway during construction, and to prevent close proximity with the new railroad bridge, the tunnel was located 290 ft to the south of the existing highway.

Soil conditions reported

The soils report made by the consulting engineers gave the general soil conditions as follows:

"The tunnel datum of El. 200 equals El 0.0 Mean Low Gulf. A top layer approximately 20 ft thick, to El. 180, consists of soft organic silty clays generally brown near the top of the layer and gray in the lower regions. The next 10 ft below this is a gray fine silty sand down to El. 170. Below this for approximately 35 ft is a layer of medium stiff gray clay or silty clay usually containing silt lenses or layers and extending down to El. 135. From this elevation down to the bottom of the 100-ft-deep holes at El. 100, there occur alternating layers of firmer materials consisting of sands, clayey or silty sands, and sandy or silty clays having shell fragments present in some layers.

"South of the centerline of the tunnel and for approximately 300 ft either side of its midpoint, the sand layer between El. 180 and El. 170 grows thinner or disappears completely. It is replaced by silts or clayey silts. At the west portal the sand layer is 10 ft thick, between El. 171 and El. 181; at the east portal it is 19 ft thick, between El. 167 and El. 186. North of the tunnel centerline, in the vicinity of the railroad tracks, the borings made by the Corps of Engineers indicate the sand stratum to be approxi-

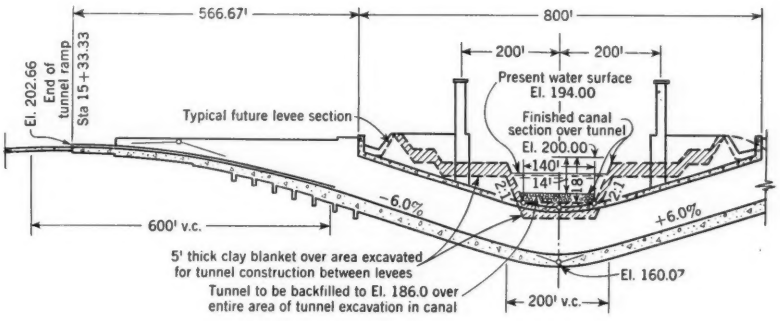


FIG. 1. Tunnel carries main state highway route, No. 31, under Intracoastal Waterway, providing two traffic lanes each 11 ft wide and pedestrian walkway 5 ft wide located over air duct.

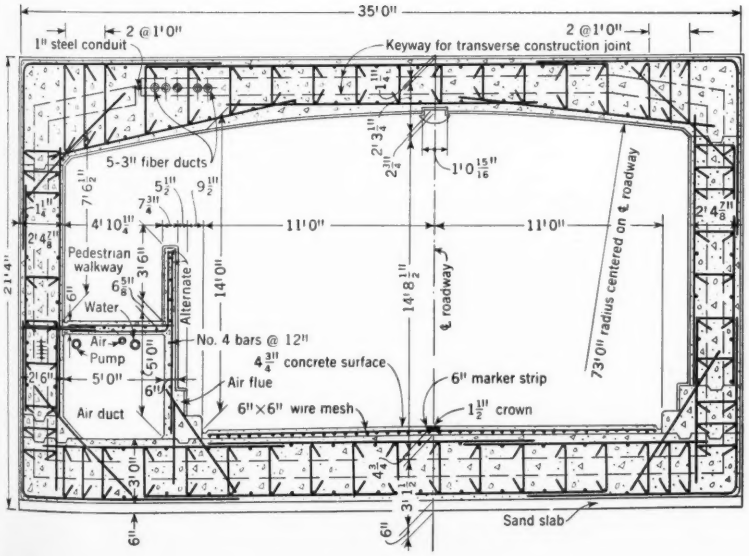
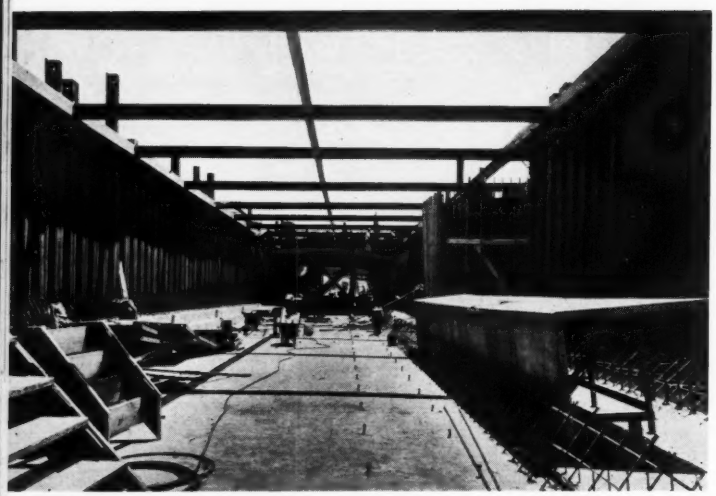


FIG. 2. Tunnel, excavated both in open cofferdam and in open cut, was built first, and waterway was constructed later. In center 200-ft length, below canal, steel armor plate ¼ in. thick covers tunnel; it serves as waterproofing as well as protection against damage from waterborne traffic above.



Since heaviest sheetpiling available was MZ-38, pressures on it had to be reduced. This was done by stripping overburden before piling was driven. Design water and soil load was 90 psf laterally. Traveling steel form 40 ft long, for pouring concrete, can be seen in background.

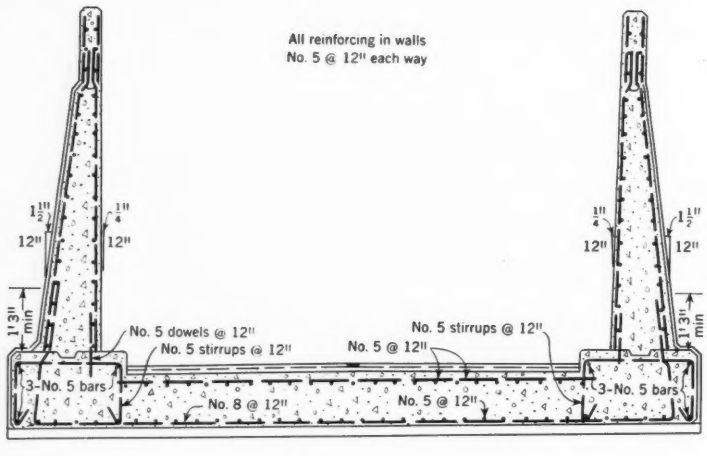


FIG. 3. Ramp section at each end of tunnel was constructed in open cut without cofferdam. Wellpoints helped in removing water and stabilizing ramp cuts. Completed ramp section appears in photo below.

mately 20 ft thick opposite the tunnel midpoint, and decreasing to approximately 10 ft thick farther east and west of this location.

"In general there seems to be no continuity of individual silt seams or strata between the various boring locations. The silt formations are apparently lenses or irregular seams and pockets rather than well defined continuous layers."

The cross section at the low point in the tunnel, which is at the center of the canal, is shown in Fig. 2. Existing ground level is approximately at El. 198 and the deepest cut is to El. 157, which is to the bottom of the sand blanket, giving a maximum depth of cut of 41 ft.

The specifications limited the side slopes in open cut to 1 on 5.5. It was decided to use a single-wall sheetpile cofferdam consisting of American sections that were readily available. This meant that the heaviest section that could be used was MZ-38. If the sheeting were driven at grade, this section would not be adequate. Therefore, the contractor decided to strip some of the overburden, which amounted to 15 ft at the center of the tunnel. Since the top of the cofferdam parallels the road grade, the depth of overburden to be stripped was reduced as the grade rose.

After excavation reached a depth of 8 ft, the soil, a wet clay, became extremely fluid and would not stand on the specified slope. First-stage wellpoints were installed in the sand stratum underlying the site and were sanded to their full height. These wellpoints removed sufficient water to permit the

slopes to stand, and removal of overburden was completed.

Sheetpile cofferdam constructed

Construction of the steel sheetpile cofferdam then began. The MZ-38 sections were driven in 60-ft lengths, the top paralleling the grade of the roadway. The cofferdam was 470 ft long and 45 ft wide and had sheetpiling on all four sides to enclose it completely.

Design of the cofferdam was based on a combined soil and water load of 90 psf laterally, which varied directly as the depth, and a uniform surcharge load of 300 psf due to construction equipment. The allowable design stress in the sheetpiling was 24,000 psi, and the maximum design moment was the simple-beam moment when the lower row of bracing was removed. This was considered a safe design based on past cofferdam experience in this area. An allowable stress of 20,000 psi was used in the wale design. The upper wale was a 24 WF 130 with struts on 20-ft centers, and the lower wale was a 24 WF 100 with struts on 10-ft centers.

The struts were designed according to the AISC Specifications for long compression members. The upper strut was a 12 WF 65, and the lower strut a 14 WF 78. Longitudinal strut bracing was an 8 WF 31 at the center line of the cofferdam.

Work was done in the following order: Excavation within the cofferdam was begun; the upper row of bracing was installed; excavation was continued until the lower row of bracing was installed; and then, when excavation to grade was completed, a working surface consisting of a 6-in. concrete slab was poured over a sand blanket.

The lower row of bracing was not removed until the base slab of the tunnel was poured. This was a precautionary measure as the weight of the base slab would minimize any tendency for the bottom to heave. Actually, there was no danger from hydrostatic uplift as the wellpoints satisfactorily lowered the water table and stabilized the area. Piezometric readings showed that the water table was lowered below the sand blanket.

As soon as sufficient base slab had been completed, the tunnel side walls and roof were poured. These were formed by utilizing two traveling steel forms, in sections 40 ft long, working from the center in both directions. The tunnel is completely lined with vitreous glazed tile. The specifications called for the ceiling tile to be placed directly on the forms and the tile grouted. Then the reinforcing steel was placed and the concrete poured. On the side walls the tile was placed after the forms were stripped. The steel forms had wires which scored the wall surface to provide better bond for the mortar. Following this, the air ducts were poured by two traveling steel forms each 40 ft long.

Membrane waterproofing was placed beneath the bottom slab on the 6-in. concrete working slab and completely encircles the exterior of the tube. It was turned up and applied to the sides and over the roof. In the center 200-ft length of the tunnel, $\frac{1}{4}$-in. steel armor plate covers the top and comes down 2 ft on each side, where it joins the watertight membrane. This armor plate is completely welded and serves a double purpose—as waterproofing and as protection to the tunnel top under the canal area to prevent damage due to sinking objects, dragging anchors, and other hazards.

Ramps built in open cut

The ramps were constructed in open cut, with the exception of a 120-ft length of the east ramp, where the Corps of Engineers required the use of cantilevered steel sheeting 30 ft long as a safeguard to their levee and spoil bank, placed after tunnel construction began. Wellpoints helped a great deal in removing the water and stabilizing the ramp cuts. A side slope of 1 on 1.5 was used, which stood quite well.

On the ramps, a 6-in. concrete slab was poured as a working surface, the bottom waterproofing membrane was applied, and the bottom slab was poured. Wall construction was quite complex as the walls were battered on both faces, were on a horizontal and a vertical curve, and were superelevated. See Fig. 3. Wood forms were used on the ramp walls. The waterproofing membrane was applied to the outside of the walls; on the inside the walls were exposed and were rubbed with a carborundum stone.

Both in the tube and on the ramp, the roadway wearing slab is $4\frac{3}{4}$ in. thick, of concrete reinforced with wire mesh.

All waterproofing membrane and armor plate on the walls and roof are protected by a 1-in. thickness of pneumatically applied cement and sand gunite. Sand backfill was placed next to the tunnel walls for a width of 5 ft. Material excavated from the sand stratum that underlies the area is acceptable for this purpose. For the backfill over the center section, between the future canal levees, a distance of 650 ft, a dense plastic clay is placed to a depth of 5 ft. For other backfill, excavated material is used. This material was stockpiled, and after it had drained it became quite stabilized and made good backfill.

Lighting and ventilation

Lighting in the tube is provided by overhead fluorescent lights, the intensity being high at the portals, gradually diminishing to allow the driver's eyes to adjust to the darkness in the tube. The intensity of light increases as the driver approaches the exit portal, and when he reaches it his eyes are adjusted to the daylight. At night and on dark days a lower light intensity is maintained.

As for ventilation, the carbon monoxide detection equipment is completely automatic, and ventilation will be automatically increased should excessive carbon monoxide be detected. There are two ventilation buildings, one on each side of the canal. Each building contains two axial-flow fans, each fan having the following capacity:

42,500 cfm at $\frac{1}{2}$-in. static pressure
35,000 cfm at $\frac{3}{4}$-in. static pressure

Pumping facilities are provided by three pump stations, one at each portal and one at mid-channel. Each pump station contains two pumps of the following requirements:

Portal pumps:		
Capacity		300 gpm each
Total dynamic head:	Min.	30 ft of water
	Max.	42 ft of water
Mid-channel pumps:		
Capacity		200 gpm each
Total dynamic head:	Min.	85 ft of water
	Max.	90 ft of water

Electric power is supplied by the lines of the Louisiana Power and Light Company, but in case of a power failure, a diesel-engine-driven generator is provided in the west ventilation building. This generator produces at continuous operation a minimum of 85 kw at a 0.90 power factor, with a 12-hour rating of 95 kw at a 0.90 power factor.

Since the tunnel is toll free, there are no toll plazas to slow the speed of traffic. The posted speed is 35 miles per hour. The tunnel is completely automatic and will require a minimum number of employees to maintain and manage it.

Construction was started March 1, 1954, and is to be completed by June 1, 1955. This is a project of the Louisiana Department of Highways. Design and supervision are by Palmer & Baker, Inc., Consulting Engineers. Construction is by R. P. Farnsworth & Co., Inc., General Contractors, New Orleans. The contract cost is $2,377,000.

For Palmer & Baker, Inc., Arthur T. Lewis is Resident Engineer and I. D. Brayshaw is Assistant Resident Engineer. For the Louisiana Department of Highways, William E. Wakefield is Resident Engineer. For R. P. Farnsworth & Co., Harold Guillot is Superintendent.

O. A. DIETZ, M. ASCE
Engineer, Maintenance Division
Panama Canal Co., Canal Zone

UNUSUAL BRIDGE

carries traffic across Gatun Locks

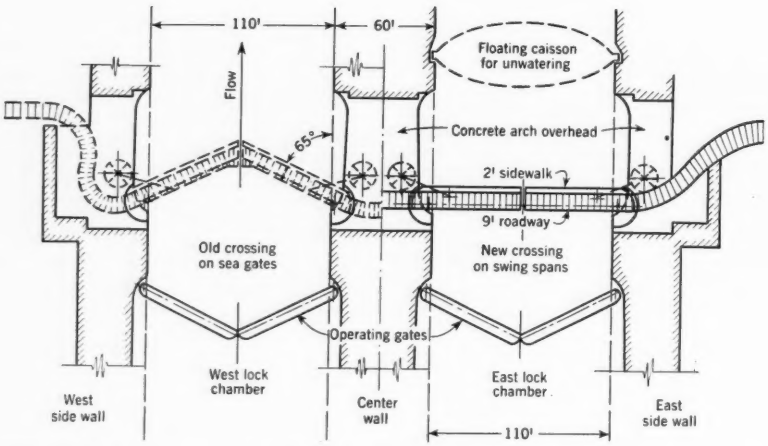
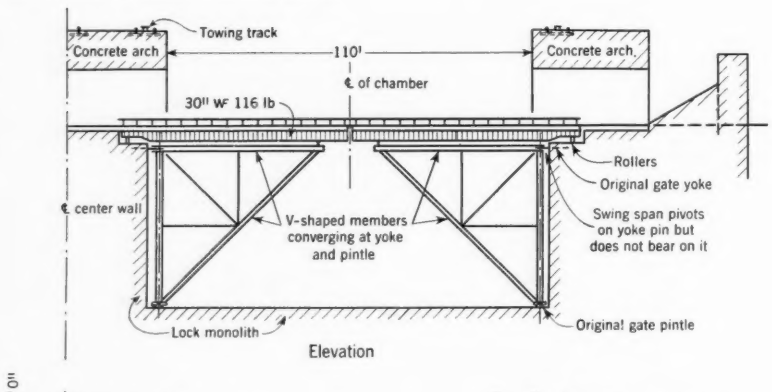


FIG. 1. In plan of lower end of Gatun Locks, old gates and bridge are in place across left-hand lock, and new bridge across right-hand lock.

FIG. 2. New bridge for vehicular traffic is seen in plan at bottom of page, and in half deck framing plan, immediately below.



On the Atlantic side of the Isthmus stand the twin Gatun Locks of the Panama Canal. When the Canal was completed, mitered sea-gates were built seaward of the lowest lock gate in each of the two parallel channels. The primary purpose of these 1,800-ton sea-gates was to provide a means of unwatering the locks for repair and periodic overhaul of the gates and valves. These sea-gates also provided, when closed, the only bridge by which vehicular traffic could cross the Canal at this end. Such crossing was somewhat difficult because the gates formed an angle of 65 deg with the lock wall, requiring vehicles to make rather sharp turns. See left side of Fig. 1.

In modernizing the maintenance facilities for the Locks, a new method of unwatering the chambers was provided which rendered the old sea-gates obsolete. The new method utilizes a floating caisson for each channel (right side of Fig. 1). This caisson is 110 ft long (the width of the chamber), 35 ft wide, and high enough to be used in all chambers. Each caisson is ballasted to provide a tight seal and is equipped for rapid dewatering of the chamber.

It was realized that, when the old sea-gates and superimposed roadway were removed, a new method would have to be found for the crossing of vehicular traffic. Two new bridges, one for each lock, were therefore designed and installed. They were officially opened to traffic in March 1954, when Lt. Col. H. O. Paxson, Acting Governor of the Canal Zone, assisted by Lt. Gen. J. Schley, former Governor, cut the ribbon in the time-honored ceremony.

The project called for the installation of two 120-ton, double-leaf, single-lane swing bridges in the same location as that of the old sea-gates. Reconstruction of the approaches was also required. The swing bridges, designed for H20 loading, without trailer, provide a straight, clean crossing of the locks (see right side of Fig. 1).

eliminating the zigzag route formerly necessary over the two pair of mitered sea-gates.

Essentially each leaf of the new bridges consists of a steel deck, curbs, and handrail supported on a pair of 30-in. wide-flange 116-lb girders on 6-ft centers. The girders rest on a triangular truss bracket (Fig. 2), which swings about a vertical member 45 ft long, terminating at its bottom in the pintle, and at its top in the yoke, of the old sea-gates. Each truss is V-shaped with its members converging on the vertical member. A strut attached between the bridge leaf and the bull-wheel ashore operates the leaf.

Structural steel and mechanical parts were shipped by the Independent Iron Works, Inc., of Oakland, Calif. At the site, the four bridge trusses and the roadway sections were assembled, riveted and welded into complete units, painted with bitumastic, and provided with cathodic protection units. The gates were then swung into place by the 250-ton floating crane *Ajax*.

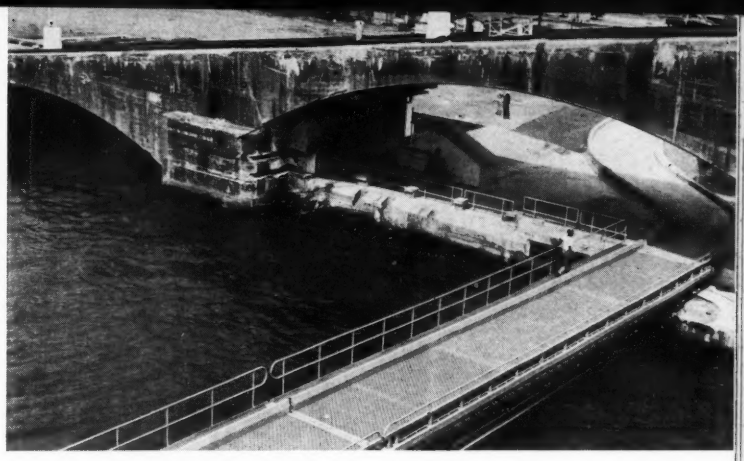
Preliminary work required the removal of the old sea-gates and the superimposed roadway. First, a floating caisson was towed to position and placed in the location shown in Fig. 1. As the chamber was unwatered, the roadway on the sea-gates was removed; plates were welded over openings and scuppers in the gates; discharge pipes were installed; and openings were made in the air chambers of the gate bulkheads to equalize the air pressure. The chambers were then flooded to El.-5 ft; six feet of water ballast was placed in the bottom of the gates; strut arms and yoke pins were removed.

As each chamber was flooded to sea level, the gates floated off their pintles. Next the gates were floated to a nearby location in the Canal, where their water ballast was blown out. As they became more buoyant, they were careened so that they floated with curved side down. Subsequently they were towed to Gatun Lake for storage. Then the lock chamber was again dewatered so that the old pintles could be replaced with new ones. This preliminary work was accomplished for both sea-gates in about three weeks.

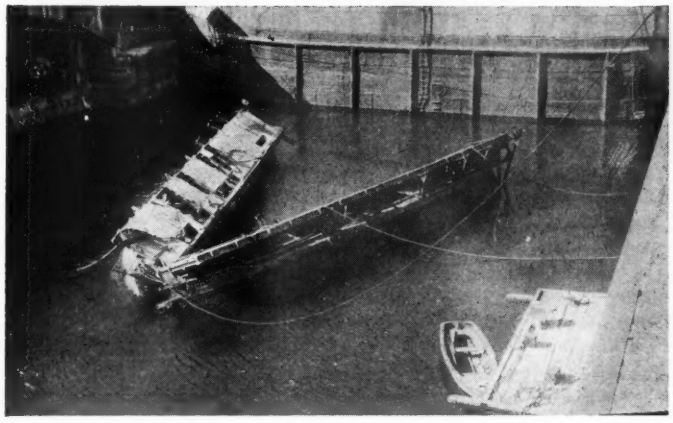
Next the chambers were reflooded one at a time; the floating crane *Ajax* was maneuvered into position; and, with a diver guiding them, the two trusses in each chamber were lowered into position over the new pintles. The deck girder sections then were lowered into place, the bridges were swung out, aligned, and shimmed. After the bridge steel was installed, the strut arms for operating the leaves were attached and adjusted to length between the span and the bull-wheel. Finally loose sections of deck grating, left off to permit attachment of lifting slings, were riveted and welded into place. Paint was touched up, grease fittings were installed, and the latching device placed. This finished the bridges.

From the date of receipt of steel to the opening of the new bridge, a period of a little over 5 months elapsed. Although the work of removing the old sea gates and the installation of the new vehicular bridge was completed in 20 days, each chamber was closed for only 10 days.

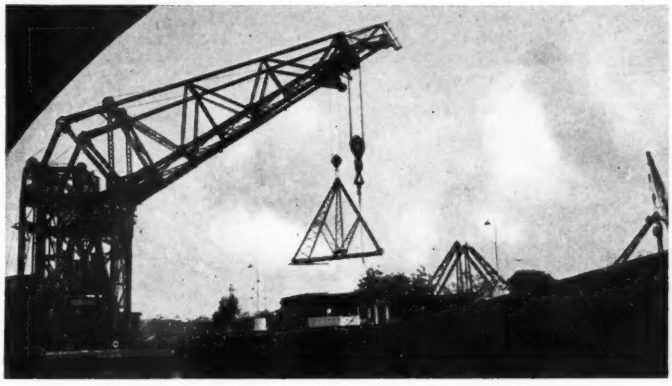
Construction was by the Maintenance Division of the Panama Canal Company from designs made in the office of the design engineer of the same company.



New vehicular bridge is completed and in place across east chamber of Gatun Locks, Panama Canal. Arch in background carries tracks for motors towing ships through the locks.



Old sea-gates have been removed and are afloat, ready to be towed to Gatun Lake for storage. Below, new bridge-truss section is being lifted into place by 250-ton crane *Ajax*.



How St. Louis analyzed its traffic problem

MYER ABLEMAN, Urban Engineer
Missouri State Highway Commission, St. Louis, Mo

One hundred years ago Ulysses S. Grant could have been seen driving a team of horses into St. Louis from his farm on Gravois Road. He would sell his produce in the market place, which was on 12th Street in front of the present Jefferson Hotel, make his purchases, and at about 5 p.m. start back home. The story has it that he would head the horses in the direction of home, and without a care in the world, or fear of danger of any kind, relax and go to sleep—to be awakened by his wife when he reached the farmhouse.

If today a guest at the Jefferson Hotel should be invited to dinner by August Busch, Jr., at his Grant farm estate, this guest probably would leave the hotel at 5 p.m. in an automobile with literally the power of 200 horses and a safe speed of fifteen times that of Grant's team. He would reach Grant Farm in about half the time it took Grant to make the trip. But this visitor would probably ask his host for a brew stronger than that manufactured by Busch's company to quiet his nerves after the wracking experience of driving 10 miles on city streets. If this modern trip is compared with that made by Grant a hundred years ago, it must be admitted that the latter was the better of the two.

The question must be asked why travel on city streets has not advanced to the same degree as that on rural highways. The obvious answer is that the street system has not kept pace with the rapid advancement in motor vehicle manufacture, including the ter-

FIG. 1. Major directional desire lines of traffic in St. Louis, Mo., metropolitan area are plotted for periods 7 to 9 a.m. and 4 to 6 p.m. Data are from 1945 origin-destination survey of Missouri State Highway Department, expanded to 1950.

FIG. 2. Time flow map for St. Louis, Mo., metropolitan area is for afternoon peak traffic hour in summer of 1950. Cars started from 6th and Locust Streets (heart of central business district) and flowed with traffic to Lindbergh Boulevard. Isographs show positions reached on 12 different routes after number of minutes indicated by circled numerals.

FIG. 1

FIG. 2

FIG. 3

rific increase in the number of vehicles. Streets have been paved and widened, but traffic conflict at cross streets has not been eliminated. Very few new arteries have been added to take care of the constantly increasing number of vehicles.

Almost every large metropolitan area in the United States is planning a freeway system to cope with traffic congestion. For the St. Louis urban area, the City of St. Louis, the Missouri State Highway Department, and the Federal Bureau of Public Roads started surveys as far back as 1945 to gather facts on the proper location of such freeways. In 1951 a report on recommended locations was completed by these three governmental agencies. The work was done by a staff working under the supervision of Col. Malcolm Elliott, M. ASCE. The freeway system in that report, "Expressway Plan for St. Louis Urban Area in Missouri," and modifications made to it since 1951, form the background for this article.

In 1945, after the termination of gasoline rationing, the Missouri State Highway Department and the Federal Bureau of Public Roads made an origin-destination survey of traffic in the St. Louis metropolitan area in Missouri. The primary method used was copied from the U.S. Census Bureau's method of sampling. Residents in every twentieth home were asked the origin and destination of motor-vehicle trips made the preceding day by people living in that particular residential unit.

This information was supplemented by questionnaires to taxicab companies, truckers, and owners of delivery trucks. The origin and destination of trips from and to areas outside the metropolitan area were learned by questioning drivers as they passed through some 100 stations at the edge of the area.

From the voluminous information made available by this survey the Missouri State Highway Department's Highway Planning Division, under the direction of S. M. Rudder, M. ASCE, compiled a report entitled "A Traffic Survey, St. Louis Metropolitan Area." This report, supplemented by supporting surveys and information, formed the basis on which the St. Louis radial expressway system was laid out.

The answer to the traffic desires of 1950 is given in Fig. 1. While the total number of trips had increased 30 percent in 1954, the general pattern had not changed. Three major desire lines radiate from the central business district: (1) immediately north and practically parallel to Natural Bridge Road, (2) directly west and along the north side of Forest Park, and (3) along Gravois Road.

There are also five minor radial desire lines nearby. Obviously all these could not be taken care of directly by an expressway. However, the locations were selected in such a manner that the major traffic desire lines would be served and so that most of the minor ones would receive some relief.

Interesting facts revealed in the origin-destination survey are that less than 1 percent is traffic desiring to pass through the area without stopping; and that only 5 percent of the traffic, exclusive of Illinois metropolitan traffic near St. Louis, has an origin or destination outside the metropolitan area.

These facts indicate that trips with both origin and destination inside the area must be transferred to new traffic arteries if congestion on city streets is to be relieved. Location of highways or freeways in a metropolitan area presents an entirely different problem from that in a rural area. In the latter case, the small volume of local traffic desiring to use the new facility would have very little influence on its location. In an urban area, however, where some 94 percent of the trips start and stop within the area, local traffic desire is the major consideration in locating freeways.

While the origin-destination survey was the main means of obtaining information for the metropolitan area, it was felt that supplemental data and supporting information were needed.

In the summer of 1948 the Missouri State Highway Department and the Bureau of Public Roads took traffic counts on practically every street in the City of St. Louis. Streets carrying over 4,500 vehicles per day were plotted. A comparison of this plotting with Fig. 1 showed that, except for the Red Feather Express Highway, a three-mile freeway along the south side of Forest Park, the desire lines, and the wide street bands were in approximately the same location. The comparison also revealed that the total traffic through different sections was approximately the same for each survey. To make a comparison between the two surveys near the completed freeway, both the major and minor traffic desire lines near Forest Park were combined.

A map was also prepared showing the population distribution according to the U. S. Census Bureau's 1950 distribution map. By assuming that the number of vehicles in an area is almost in direct proportion to the number of people living in it, it was found that the distribution map also supported the origin-destination survey. It was learned that the number of people per vehicle decreased as the distance from the central business district increased.

The fact that there is a large volume of traffic desiring to travel along a route

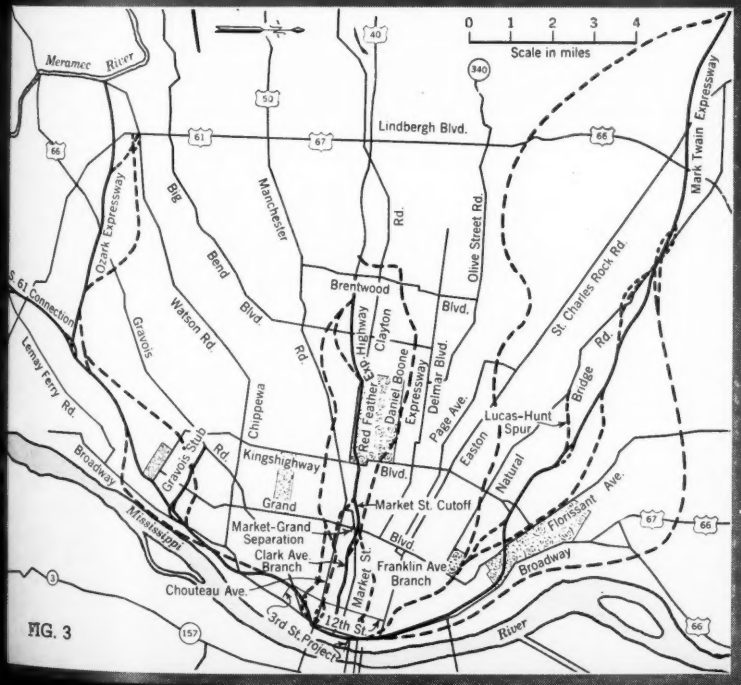


FIG. 3

FIG. 3. Locations investigated for expressways in St. Louis metropolitan area are shown by dashed lines, and locations chosen for three radial routes are shown by solid lines.

does not necessarily mean that traffic arteries serving this desire are congested. If these arteries are numerous, wide, and free flowing, with no bottlenecks, the widest desire line might not need relief.

To learn about congestion on radial routes during the peak traffic hour, a time flow survey was made (Fig. 2). Cars started from 6th and Locust, the heart of the central business district, and flowed with traffic to Lindbergh Boulevard, which is considered the boundary of the metropolitan area. Twelve routes were traveled, each on three different occasions. The location of the car was recorded at the end of each minute throughout the trip.

Time contours were then plotted indicating the distance traveled at the end of each 5-min period during the peak hour (Fig. 2). It is interesting to note that this map shows travel throughout the Red Feather Express Highway to be much faster than that along any other traffic artery. At the ends of this expressway, traffic is held up by stop signals for cross traffic. It was also noted that east and west of this freeway traffic moved at about the same speed as on other streets.

With all the information available, investigations were made on alternate locations for each of the three radial routes coming into St. Louis. The general directions of these radial routes are: (1) To the southwest, the Ozark Expressway; (2) directly to the west, the Daniel Boone Expressway; (3) to the northwest, the Mark Twain Expressway—all radiating from the central business district.

After a large amount of field investigation, supplemented by aerial photographs and contour maps, which were coordinated with the origin-destination and time surveys to learn whether traffic would be relieved on the streets, three recommended routes were selected, plus a supplemental route for local traffic along the north side of Forest Park. Cost estimates played a part in the selection.

All the locations investigated are shown in Fig. 3. Each location was completely analyzed as to cost, plan and profile, length, and traffic service. As a result of this analysis, locations were chosen for the three recommended routes, also shown in Fig. 3.

Ozark Expressway. The recommended route of the Ozark Expressway is near Broadway, in the City of St. Louis, until it reaches the city limits. Traffic would actually be better served by a location nearer Gravois Avenue. However, the tremendous right-of-way cost on a location of this kind and the uprooting of so many fine homes and businesses precluded the possibility of a route along Gravois Avenue. It was found that the recommended route, plus a two-mile stub intersecting Morgan Ford Road and Gravois Avenue, would cost less than a direct route and would actually serve both the major and minor desire lines along Gravois and Broadway. It was also noted that the difference in mileage between coincident points on Gravois Avenue and on the expressway requires only one mile more of travel on the expressway, and that the travel time could be cut in half. All these facts helped in deciding on the recommended location.

Daniel Boone Expressway. This expressway is completed in St. Louis County from Brentwood Boulevard west. Locations were investigated from Brentwood Boulevard east to the central business district.

Alternate "B" which is located parallel to, and less than one mile south of, the present Red Feather Express Highway, was discarded because it would be located along a minor directional desire, which was already being served by the Red Feather Highway. To relieve the most congestion, the route should be located along the north side of Forest Park where the highest traffic volume directional desire was located. However, it was found that the volume of traffic desiring to use this route was so high during the peak hour that a six-lane expressway could not handle it. Six lanes was the widest expressway that could be designed along Forest Park Boulevard.

The final recommended location of the Daniel Boone Expressway was Alternate "A." This would take care of traffic from west of Brentwood Boulevard traveling east and west, and would also open up the bottlenecks at each end of the present Red Feather Express Highway. This highway, now four lanes, is to be widened to six lanes when funds are available and traffic warrants.

To take care of the major directional desire along the north side of Forest Park, it was recommended that Alternate "C," which is the route along the north side of Forrest Park, be constructed from the central business district west through the Clayton business district as a local expressway. If this location were connected to the state route, six lanes could not carry the afternoon peak-hour traffic. The fact that the traffic west of Brentwood Boulevard would not be funneled into this local route, would reduce the traffic desire in this peak hour to the point where six lanes would have sufficient capacity.

The construction of both these routes would increase the cost by $8,000,000 over a through route on Alternate "C" along the north side of Forest Park. The two routes would serve both a major and a minor directional desire.

Because of these facts both the through route along the south side of Forest Park (Alternate "A") and the local route along the north side (Alternate "C") were recommended.

The Mark Twain Expressway. The location for this route was selected by following as nearly as possible the center of gravity of the traffic desire and at the same time considering the minor desire along Broadway.

It was found that the street carrying the largest traffic volume in St. Louis and St. Louis County is Natural Bridge Road, and that traffic is increasing faster on this street and others paralleling it in a northwest direction than on any other streets in the metropolitan area. The biggest problem in locating the Mark Twain Expressway therefore was to relieve Natural Bridge Road and complimentary streets.

The original recommended route in the "Expressway Plan" report ran almost parallel to and near Natural Bridge Road throughout its length. However, because of the opposition of groups along this route, St. Louis Mayor Raymond R. Tucker, requested the Missouri State Highway Commission to make additional studies.

A new location along Broadway to O'Fallon Park and then through the park was found to be only 0.3 mile longer. While it would not serve traffic on Natural Bridge Road as well as the original route, it would serve the minor desire along North Broadway. It will reduce the present street time required to reach the new administration area of the airport from the central business district by about 20 minutes. For all these reasons and because the cost would not be any greater on this route than on any alternate route, the revised recommended route was selected.

The recommendations include the use of distributor streets around the central business district. For example, both the Ozark and the Mark Twain Expressways end on a wide Third Street, which will be used to distribute traffic into parking garages and streets to the west. The Daniel Boone Expressway uses Clark and Walnut Streets as distributors to the central business district.

Market Street Cutoff is part of proposed 8-mile Daniel Boone Expressway, one of major urban expressways planned for St. Louis metropolitan area. Cutoff, drawn in on air view at top, runs diagonally from Tower Grove to Spring and Market. In lower view, cleared right-of-way in form of

Because 90 percent of the traffic does not desire to go beyond this area, it was felt that a continuous expressway was not economically feasible. Some engineers who locate urban expressways forget that, if existing streets are not congested, there is no good reason why they cannot be used to distribute traffic.

It might be noted that the investigation did not recommend any north-south routes, although the fact that north-south routes are needed was mentioned in the "Expressway Plan" report. The total cost of $160 million estimated for the three radial routes indicated that these routes were as far as the Missouri State Highway Department could go on expressways at this time. North and south routes are therefore considered primarily as local problems. Only if the Department's revenue increases tremendously will they be included.

In conclusion it is emphasized that much of the progress that has taken place in the past one hundred years is due to the development of transportation facilities. St. Louis' present streets and roads are a tremendous improvement over those of Grant's day, a hundred years ago. However, in the metropolitan area much must be accomplished in the construction of freeways to catch up with the motor vehicle industry and the desire of its customers.

Only two miles of a 42-mile expressway system have been completed in the St. Louis urban area. Road plans have been completed for 15 of the other 40 miles. State and federal funds will be available to build most of these 15 miles within the next three or four years. The City of St. Louis and also St. Louis County outside the city limits, must furnish funds for 50 percent of the cost of right-of-way. The city's share was made available through a bond issue passed on May 26, 1955. Right-of-way is now being purchased within the city limits. This fact will allow expressway construction in the St. Louis area to be accelerated. It cannot happen too soon.

(This article is based on the paper presented by Mr. Ableman at the ASCE St. Louis Convention, before the Highway Division session presided over by Emmett H. Karrer, vice chairman of the Division's Executive Committee.)

dog leg shows construction in progress on another part of St. Louis' urban expressway system—south section of Third Street route. Two-mile length, built at cost of $13,500,000, was recently completed and opened to traffic. St. Louis *Post-Dispatch* Sunday PICTURES Photos.

ST. LOUIS AIR TERMINAL

Roof consists of three identical domes formed by intersecting circular barrel segments. Movable forms for a dome consisted of 11 carefully selected segments, mounted on wheels and moved on system of steel rails at right angles to each other. Photo at left shows three form segments partially erected. Photo above

Intersecting ribs carry concrete

Intersecting circular barrel segments, which in plan form an eight-sided figure (Fig. 1), will make the terminal building at the Lambert–St. Louis Municipal Airport a striking landmark for many years to come. Except for the roof the terminal is, in a structural sense, just another building of ordinary reinforced concrete construction.

It is 415 ft long, 123 ft wide and three stories high, with only utility space below grade. The ground floor is known as the "apron level"; 12 ft above it is the "finger level," while 12 ft above that is the "passenger level." A shell roof covers the passenger level, providing an unobstructed area 412 ft long and 120 ft wide. See Figs. 2 and 3.

Floors are of flat slab construction 8 in. thick with square drops, caps, and columns. The column spacing is regular at 24-ft centers, except the bays between roof domes, which are 26 ft. The passenger level has a 7-ft overhang around the building.

Spread footings on firm clay at 3000 psf support all construction.

Expansion joints are provided only at intervals in the passenger-level overhanging slabs and between the roof domes.

All reinforced concrete was designed on the basis of 3000-lb concrete and the use of rail steel in accordance with the ACI code.

Six sacks of cement per cubic yard was provided, and test cylinders show that concrete is well in excess of the 3,000-psi strength requirements.

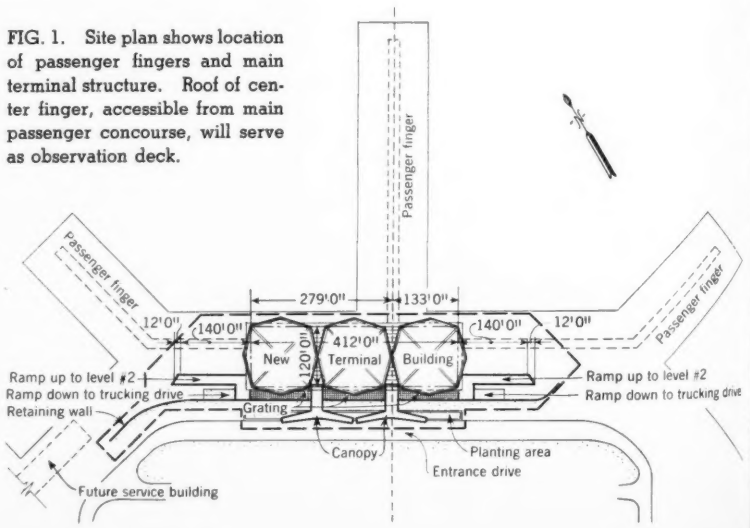
Three identical domes

The roof consists of three identical domes formed by intersecting circular barrel segments which, in plan, form an eight-sided figure. At the center of each side of a 120-ft square is a 13-ft triangular overhang. It is the triangular overhang on each side of the 120-ft square that forms the eight-sided figure. The maximum width across the top of the dome is therefore 126 ft.

Between domes are expansion joints and skylights which follow the curvature of the shell. The clear center height of the dome is 32 ft.

The domes consist of reinforced concrete shells $4\frac{1}{2}$ in. thick, with diagonal

FIG. 1. Site plan shows location of passenger fingers and main terminal structure. Roof of center finger, accessible from main passenger concourse, will serve as observation deck.



shows roof construction. Domes are covered with copper on plywood fastened to 2 × 4 nailers attached to shell. Fiber-glass insulation is provided between nailers. Next photo shows pouring of dome concrete. Each dome contains about 400 cu yd of concrete and 60 tons of reinforcing steel, and was poured in one continuous operation. Tower shown at right in this photo was later abandoned and all concrete was lifted to hoppers by crane. In photo directly above, window framing is in place. Vertical steel members of windows carry no load from dome; they are provided with slotted connections at the dome.

roof shell

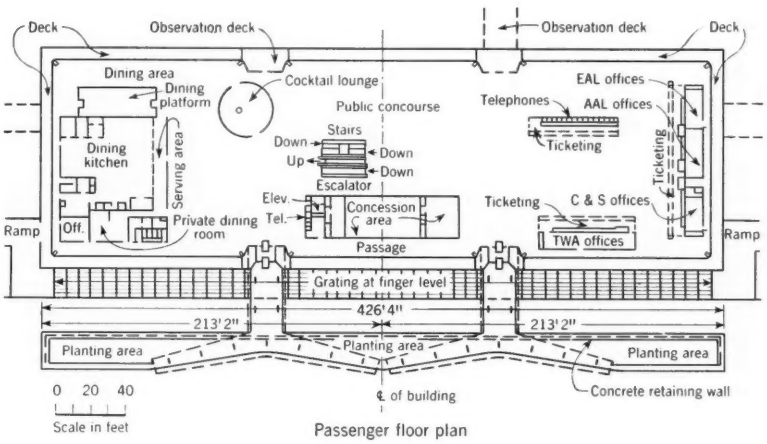
WILLIAM C. E. BECKER, M. ASCE, Consulting Engineer, St. Louis, Mo.

Right:

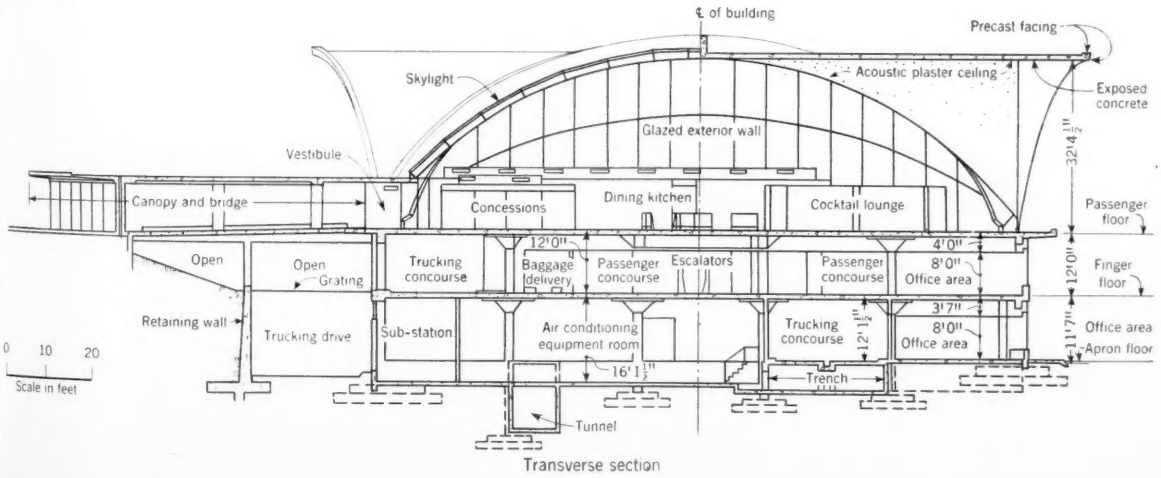
FIG. 2. Main passenger concourse provides ticket facilities grouped to right, centralized concession area convenient to passenger flow, and spacious dining area to left. Passengers will go to planes from floor below.

Below:

FIG. 3. Transverse section shows separation of terminal operations. Passengers will enter from left, under canopy and across bridge. Baggage and enplaning facilities are on floor below, and mechanical equipment and terminal services are on lowest floor.



Passenger floor plan



Transverse section

and perimeter stiffening ribs, all above the shell except near the four corner supports, where the diagonal ribs extend below the shell into a structural-steel hinged bearing. See Fig. 4. The thickness of the shell is increased to 8 in. at the perimeter ribs.

The stiffening ribs were kept above the shell to facilitate economy in formwork and at the same time to provide good architectural treatment. While the triangular overhanging segments add interest to the appearance they are also helpful structurally in that the perimeter stiffening ribs produce reverse bending in the shell at its maximum span.

The diagonal ribs are 18 in. × 45 in. at the crown, and at the hinged structural steel support the bearing area is 24 in. × 40 in. The perimeter ribs are 18 in. wide and 20 in. high, and the section is a parallelogram, not a rectangle.

Typical reinforcing of the $4^1/_2$-in. shell is No. 3 bars 12 in. on centers both ways top and bottom.

The roof domes are covered with copper on plywood fastened to 2 × 4 nailers attached to the shell. Fiberglass insulation is provided between nailers, and a metal lath and plaster ceiling is hung from below the shell with monel metal ties cast in the shell.

The perimeter ribs are faced with prefabricated terrazzo slabs, which were held in place by the forms and anchored monolithically to the ribs.

Steel bearings and ties

It was decided to provide hinged steel bearings at the four corner sup-

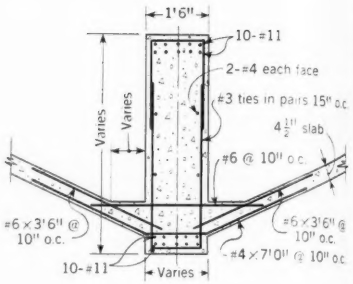
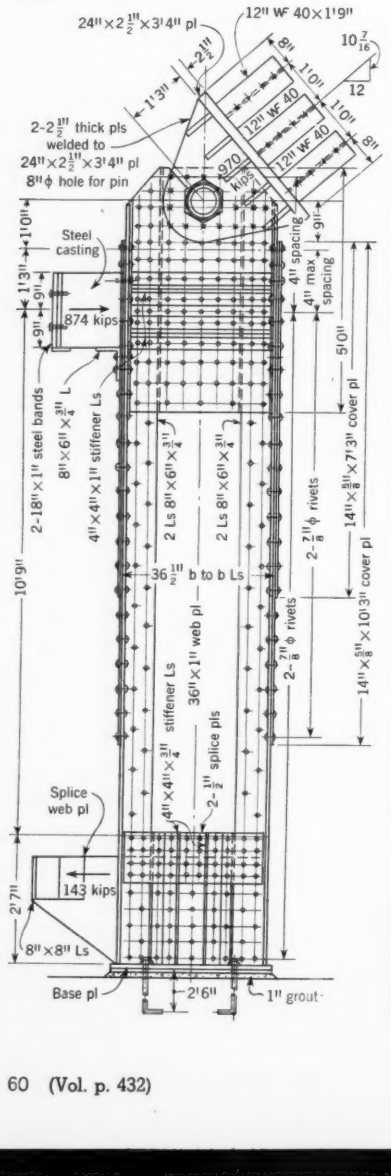
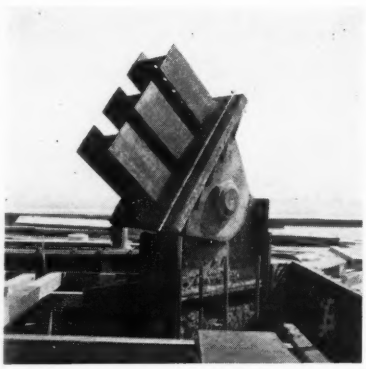


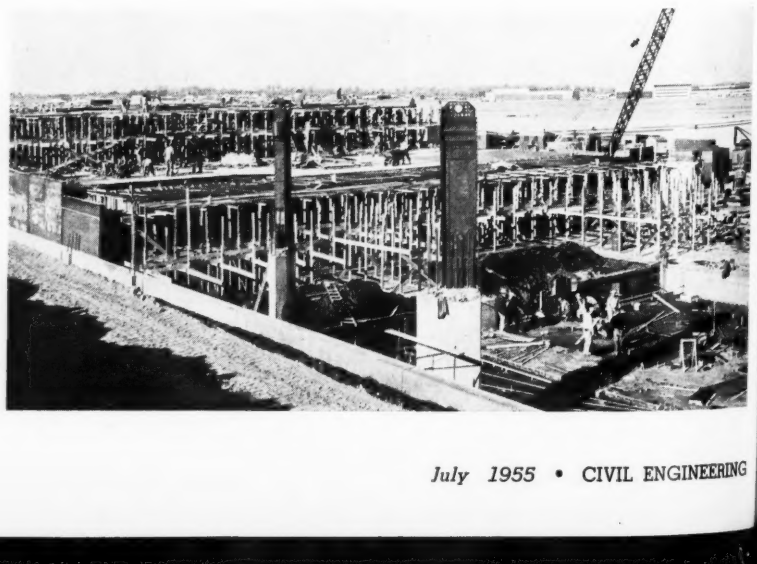
FIG. 4. Diagonal stiffening ribs are all above shell except near four corner supports, where they extend below, into hinged bearing. Typical cross section of rib at intersection of barrel shells shows arrangement at point 21.21 ft from end of arch, where rib extends slightly below shell.

FIG. 5





Hinged steel bearings (photo above, left) are provided at four corner supports of a dome to assure more determinate distribution of stresses and to facilitate construction. Also it was decided to neutralize all horizontal reactions at passenger level by providing structural steel ties around the 120-ft square. (Photo above, right, shows staggered bolted connection of ties.) Center of 8-in. pin bearing (Fig. 5, at left) is one foot above passenger-level floor. Transfer of 874-kip horizontal thrust from diagonal stiffening rib of dome to steel ties is through steel casting fastened to column (shown in photo below).



ports of a dome in order to assure a more determinate distribution of stress and to facilitate construction. Also, it was decided to neutralize all horizontal reactions at the passenger level by providing structural steel ties consisting of two 18-in. × 1-in. plates in the spandrel and interior beams around the 120-ft square and to bend them around the corner structural steel columns. The center of the 8-in. pin bearing is one foot above the passenger-level floor. The steel columns, which are 36-in.-deep built-up sections with a 36-in. × 1-in. web, four angles 8 × 6 × $^3/_4$ with 14-in. cover plates extend from about 2 ft 6 in. below the finger level for a height of about 16$^1/_2$ ft. Transfer of the 874-kip horizontal thrust from a diagonal stiffening rib to the steel ties is through a steel casting fastened to the column. This provides a simple and effective detail. See Fig. 5 and photos on facing page. The maximum stiffening-rib reaction is 970 kips.

It is an interesting fact that the same amount of material would be required in the case of a square to neutralize the horizontal reactions by providing either diagonal ties or ties along the perimeter as was done. To provide perimeter ties is obviously more practical.

The horizontal reaction at the base of the steel columns is neutralized by steel struts embedded in the first length of concrete beams framing into the corner columns.

Since it was necessary to construct the roof after embedding in the construction the steel ties which will neutralize the horizontal reactions of the stiffening ribs, it was an interesting subject for consideration as to how much structural steel should be embedded in the concrete floor framing to take a thrust of 874 kips and still stay within acceptable "cracking limits."

The design stress in the ties is 17,200 psi, while the "estimated" stress in structural steel and reinforcing steel in combination is about 12,000 psi. To make what could be a long story short, from all indications the choice of the amount of steel used in the ties has apparently been successful. No objectionable cracks in the concrete are visible; there are a few but they were not visible until watermarked when water seeped through.

Concerning possible cracks in the passenger-level floor resulting from the roof construction, there is a very fortunate detail of finish. On the structural floor will be provided a 3-in. finish, and it will be applied after the domes are completed so that the only increment of stress that will affect the floor framing will be the live load on the domes, and we know that the actual live load will be much less than the design load.

Strain gages show stresses

In collaboration with Prof. A. W. Brust of Washington University, 39 SR4 strain gages were attached to the steel ties of the east dome before the floor was poured, and these gages were read before and after the roof forms were released.

Some difficulty was experienced in getting the steel ties into proper alignment. Readings taken on the strain gages after forcing the steel ties into proper alignment indicated local stresses beyond the elastic limit.

The readings taken after the roof forms were released indicated stresses of the order of 8,000 psi. These stresses approximate those "estimated" by calculation.

There was no indication from the readings that the stress at the center of a 120-ft side was less than that near columns. It would not have been surprising if such results had been obtained because the reinforcing steel and the concrete certainly unavoidably absorb some of the stress intended for the steel ties.

Movable forms for dome

The contractor decided to use a set of movable forms for a dome, and they consisted of 11 carefully selected segments which involved a sequence of 18 separate movements of the 11 segments for a setup for the next dome. These form segments were mounted on wheels and were moved on a system of steel rails at right angles to each other. Each segment was provided with jacks for vertical adjustment for decentering and clearance, so that a form segment could be relocated for the next dome. The use of these movable forms required the erection of temporary supporting falsework on one end of the building, and its reerection at the other end, to relocate the forms in the last dome constructed. The advantage, from a construction standpoint, of placing all stiffening ribs above the shell is evident. That the formwork was rather involved at the bearings requires no imagination to understand.

Each dome was poured in one continuous operation. The west dome was poured in 18 hours on June 17, the center dome in 12 hours on Aug. 31 and the east dome in 14 hours on Oct. 28, 1954. Double forms were used at the corners on the first dome but the upper forms were discarded shortly after the pouring of concrete began. Concrete was cured by sprinkling.

Decentering of a dome was carried out after control beams indicated a modulus of elasticity of the concrete of 3,000,000 psi. Measured deflections after removal of forms from the west dome were of the order of $^1/_4$ in. at the center of the windows, and 1$^1/_4$ in. in the center of the dome, indicating phenomenal stiffness. The vertical steel members of the windows carry no load from the dome; they are provided with slotted connections at the dome.

A dome contains about 400 cu yd of concrete and about 60 tons of reinforcing steel. The reinforcing steel averages about 6.8 lb per sq ft of horizontal projected area. It is an interesting fact that the actual surface area of the dome (not including stiffening-rib sides) is only about 7 percent more than the horizontal projected area.

As closely as this writer can ascertain, the cost of the structural domes is about $3.25 per sq ft of projected area, or about $57,000 per dome.

The cost of the Terminal Building is about $3,600,000 while that of it and the fingers and auxiliary buildings is about $6,700,000. The total cost of the terminal building is about $23.50 per sq ft of gross floor area.

The roof of this building is not the most economical construction that might have been provided. However, it will be the most striking landmark of the St. Louis Airport for many years to come. The hope is entertained by many that some sort of a memorial will be created in this Terminal Building to honor Lindbergh and his world famous flight in the *Spirit of St. Louis* to Paris.

The project is being carried out under the direction of the Municipal Airport Commission, of which Conway Briscoe is chairman. Frank J. McDevitt, President of the Board of Public Service of St. Louis, is in charge of all contract work, with Walter R. Crecelius, M. ASCE, Chief Engineer of Bridges and Buildings, in charge of supervision and field inspection of the work. E. A. Schmitz M. ASCE, is field engineer for the city.

The architects are Hellmuth, Yamasaki and Leinweber; the mechanical and electrical engineers are Ferris & Hamig; and the consultants on the general layout of the project are Landrum & Brown. The general contractor for the building is the L and R Construction Company.

Roberts & Schaefer are the consultants on the design of the domes, with Anton Tedesko, M. ASCE, in charge. The writer is the Structural Engineer of the project.

(This paper was originally presented by Mr. Becker at the ASCE St. Louis Convention, before a Structural Division session presided over by Warren Raeder, a member of the Division's Executive Committee.)

ENGINEERS' NOTEBOOK

Miniature aerial photography illustrates basic principles

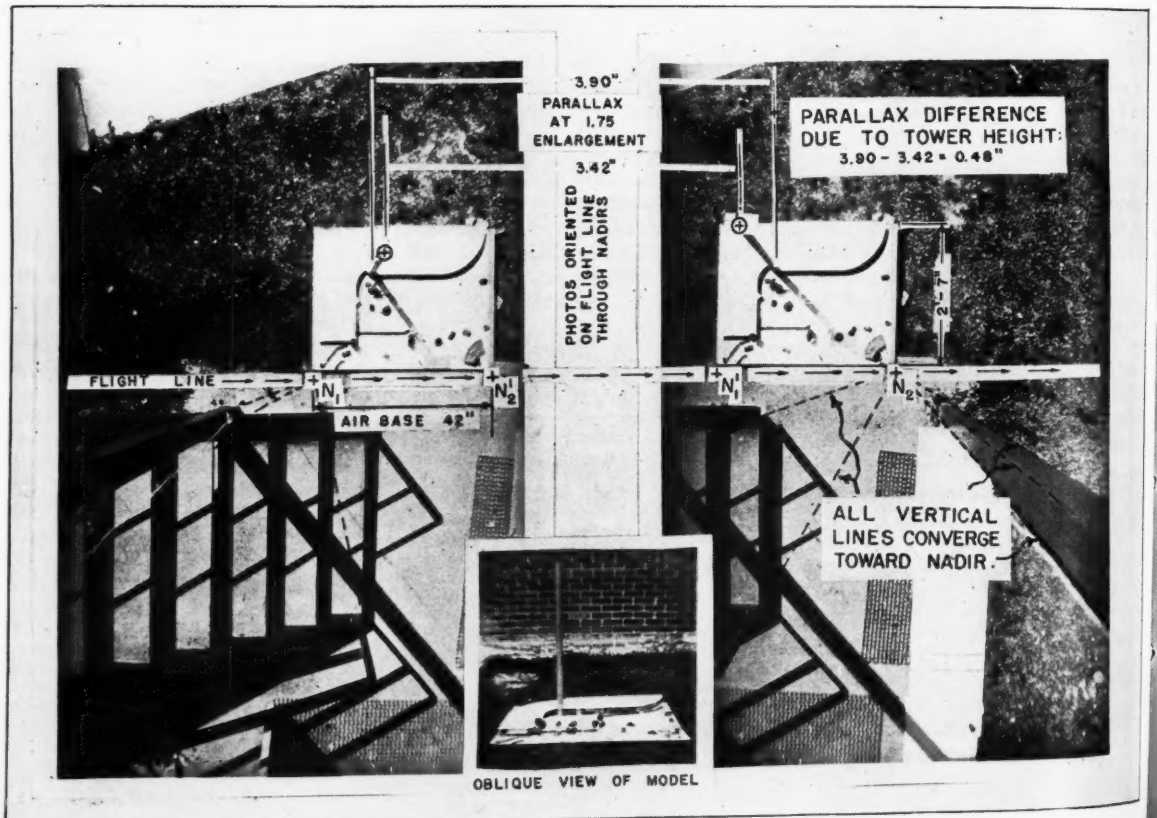
A. N. WINSOR, A.M. ASCE, Assistant Professor, University of Florida, Gainesville

Miniature aerial photography can be a project activity for students of elementary photogrammetry or anyone who is interested in taking a closer look at basic photogrammetric principles. Such photography may promote better understanding through the use of exaggerated relief models which emphasize displacement and permit reasonable accuracy of measurement with ordinary engineer's scales, yard sticks, or metallic tapes. Of course an error in measurement will be magnified approximately in the ratio of photo size to model size but not to the extent encountered in true aerial photography, where an error of 0.01 in. may represent fifty or more feet on the ground.

In the example illustrated, the object employed was a 3-ft 6-in. × 2-ft 7-in. scale model of a community center. A 36-in. mailing tube served as a chimney or tower of exaggerated height, and a box kodak, elevated 168 in. on a fire escape, was used to take overlapping pictures above each of the two lower corners of the model. The vertical members of the fire escape were intentionally included to provide data for locating the nadir point beneath the lens regardless of the tilt of the hand-held camera.

The resulting photographs, oriented along the flight line through the nadir points, illustrate the exaggerated effect of relief as a component of image displacement. In true photogrammetry,

Two photos, taken from different points on a fire escape, show model of community center 14 ft below. Tower has exaggerated height of 36 in. Note how all vertical lines converge toward nadir.



relief is generally provided by gently rolling ground and the base of a hill cannot be seen. Nevertheless, a hilltop, unless directly beneath the camera, is displaced relative to its correct map position. The direction of relief displacement is radial with respect to the nadir point regardless of intentional or accidental tilt of the camera. This is a fundamental concept of photogrammetry and as such it is clearly illustrated in each of the photographs by the convergence of the vertical members of the fire excape toward a common nadir point.

Photo enlargement necessary

The scale of an approximately vertical photograph at a designated datum level depends on the relative height values of similar triangles in which f (camera focal length) and H (camera height) are the controlling factors. Hence, the scale of a contact print is proportional to the focal length of the camera. However, in miniature aerial photography, the contact print from an ordinary camera is too small for practical measurement with accuracy, and considerable enlargement is usually desirable.

Photographic enlargement at a ratio m has exactly the same geometric effect on an aerial photograph as taking the photograph with a camera whose focal length is m times f. But if there are elevation differences, the effect is not identical with that obtained by taking the photograph from a different height.

Height of tower calculated

Assume that it is desired to calculate the height of the tower, h, by means of parallax measurements of the tower base and tower summit. The term parallax is used to designate the apparent displacement of the position of a body with respect to a reference point caused by a shift in the point of observation.

Given:

A photo enlargement of 1.75 (considerably larger than illustrated).

Parallax difference between tower base and summit of 0.48 in.

f = 4 in.; effective f = 4 × 1.75 = 7 in.

H = 168 in.

Photo air base w (distance between projected nadirs on a single photo) = 1.75 in.

The parallax formula is $P_x = \dfrac{wf}{H-h}$, in which P_x represents the air base w, plus or minus the parallax difference due to positive or negative relief, and h = height of tower.

$$1.75 + 0.48 = \frac{42 \times 4 \times 1.75}{168 - h}$$

h = 36.2 in., height of tower.

As for accuracy, it is probable that if several persons were to make independent calculations based on a rough scaling of distances, the tower height might vary several inches above or below 36 in.

Other spacial relationships that could be investigated are the degree of tilt and the radial displacement of the tower summit on each of the two photographs.

Fractions of inches simplified

WILLIS G. PRATT, A.M. ASCE, Field Engineer, Project Division, Oxford Paper Company, Rumford, Me.

Computations involving fractions of inches with various denominators can be tedious as well as difficult, especially in the field, where tables and adding machines are not available.

A tolerance of only $^1/_{64}$th of an inch is often necessary when aligning and leveling line shafts and machinery, also when squaring up equipment to a baseline or centerline by transit, such as dryers and rolls on a paper machine. Fractions are also dealt with on plans, for example when adding up several dimensions to get the overall length.

To eliminate the fractions, all that is necessary is to use four separate units to express the reading, breaking it down into feet, inches, sixteenths, and sixty-fourths, instead of feet, inches, and fractions of inches.

For instance, 7 ft $9^{27}/_{64}$ in. would be written as 7 ft, 9 in., 6 sixteenths, and 3 sixty-fourths. To add 5 ft $7^3/_{32}$ in. to this, write:

	7′	9″	6^{16}	3^{64}
+	5	7	1	2
	12′	16″	7^{16}	5^{64}

Combining, this becomes 13′ 4″ 8^{16} 1^{64}, or 13 ft $4^{33}/_{64}$ in.

To subtract, the procedure is simple:

	7′	9″	6^{16}	3^{64}
−	5	7	1	2
	2′	2″	5^{16}	1^{61}, or 2 ft $2^{21}/_{64}$ in.

When leveling, where the difference is only a fraction of an inch, only the last three units would be used. Thus suppose a rod reading was $9^{13}/_{16}$″ on one end of a roll and $9^{55}/_{64}$″ on the other end. The readings would be read and recorded as 9″ − 13^{16} − 0^{64} and 9″ − 13^{16} − 3^{64}. At a glance you can tell that the roll is $^3/_{64}$″ out of level. The signs of the units are omitted for speed and you would write 9 − 13 − 0 and 9 − 13 − 3. Practice in always reading and recording to three or four places, as the case may be, cuts down on errors.

By way of illustration, assume that we wish to add up the various dimensions on a plan of a piece of machinery to check the overall length. In Table I, the dimensions are tabulated in three ways—(1) the conventional manner, (2) reduced to sixty-fourths by the simplified method, and (3) by decimals, usually the most convenient method to

TABLE I. Plan dimensions added by three methods

Conventional Method	New Method	Inches, in Decimals
$5\ ^1/_4$″ = $5^{16}/_{64}$	5″ 4^{16} 0^{64}	5.25
$^7/_{64}$″ = $^7/_{64}$	0 1 3	0.109375
$6\ ^1/_8$″ = $6\ ^8/_{64}$	6 2 0	6.1250
$^{41}/_{64}$″ = $^{41}/_{64}$	0 10 1	0.640625
$12\ ^1/_2$″ = $12^{32}/_{64}$	12 8 0	12.50
$^{11}/_{32}$″ = $^{22}/_{64}$	0 5 2	0.343750
$4\ ^3/_{16}$″ = $4^{12}/_{64}$	4 3 0	4.1875
$^{17}/_{32}$″ = $^{34}/_{64}$	0 8 2	0.531250
$7^{15}/_{16}$″ = $7^{60}/_{64}$	7 15 0	7.9375
$34^{232}/_{64}$	34″ 56^{16} 8^{64}	37.625000

Combining to 37″ 10^{16} 0^{64} or $37^5/_8$″

use in the office where tables and adding machines are available.

In nearly all cases, by the new method, the addition is easily done mentally. If feet are also involved, they are added in an extra column on the left.

After using this method for a while. the engineer will probably find himself using it to add the more simple fractions of feet and inches, even though the common denominator may be only 4 or 8. For example:

CONVENTIONAL METHOD

1′	$11\frac{1}{2}''$
2′	$3\frac{3}{4}''$
2′	$1\frac{3}{8}''$
1′	$4\frac{1}{4}''$
7′	$8\frac{7}{8}''$

NEW METHOD

1′	11″	8^{16}	0^{64}
2	3	12	0
2	1	6	0
1	4	4	0
7′	8″	14^{16}	0^{64}

For very small readings, only the last two columns are necessary, and the right-hand column always denotes 64ths. Thus $\frac{5}{32}''$ plus $\frac{7}{64}''$ becomes

$$\begin{array}{cc} 2 & 2 \\ +1 & 3 \\ \hline 4 & 1 = {}^{17}/_{64}'' \end{array}$$

Subtracting $\frac{7}{64}''$ from $\frac{5}{32}''$ becomes

$$\begin{array}{cc} 2 & 2 \\ -1 & 3 \\ \hline 0 & 3 = {}^{3}/_{64}'' \end{array}$$

On one occasion, where extreme accuracy was required in leveling the shaft of a condensing turbo-generator, a surveyor's level and a scale graduated to 64ths of an inch were used, and readings taken to a quarter of a 64th of an inch, or 0.004 in., using good illumination on the rod and a close set-up. In the notes, the readings were merely carried one step further, recording inches, sixteenths, sixty-fourths, and quarters of sixty-fourths, or 256th of an inch.

Two of the actual readings were:

$$\begin{array}{cccc} 7'' & 11^{16} & 3^{64} & 1^{256} \\ -7 & 10 & 1 & 3 \\ \hline 0'' & 1^{16} & 1^{64} & 2^{256} = \frac{5\frac{1}{2}}{64} \text{ in.} \end{array}$$

Multiplication of fractions of feet and inches is also very easy by this method. Suppose there are seven equal spaces of $4^{29}/_{64}''$ each and the overall distance is desired.

$$\begin{array}{cccc} \text{Write it as} & 4 & 7 & 1 \\ & & & \times 7 \\ \hline & 28 & 49 & 7 \end{array}$$

or $31 \quad 2 \quad 3 = 31^{11}/_{64}''$

If it is also necessary to measure off this distance with a rule, it is easier to locate the 31-in. mark, go two-sixteenths further plus three-fourths of another sixteenth, than to locate $^{11}/_{64}$ths beyond the 31-in. mark, and there is less chance of error.

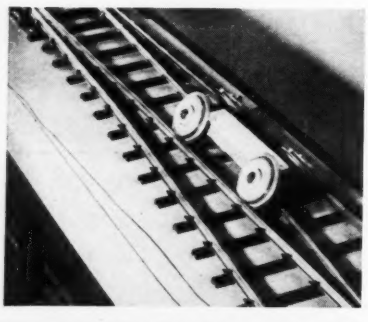
THE READERS WRITE

V-type system proposed for elevated rapid transit

TO THE EDITOR: The article about "A Monorail System for Los Angeles," by Mr. Burpee in the April issue (p. 33), has been read with interest. The study of Coverdale & Colpitts, New York, was limited to monorail construction by legislative enactment.

Monorail construction has been in practical use at Wuppertal-Elberfeld, Germany, and in Scotland (Bennie). Wagner, Kruckenberg and others have designed monorails. However all these monorails look beautiful in the design stage and on artists' sketches, but are much less exciting in reality.

Before the last World War we made an extensive study of different systems, among others a monorail system. We found that the use of an elevated V-type rail and car-suspension system (Fig. 1) would reduce the cost to less than half that of a monorail system. This study was made at the Swiss Federal Institute of Technology (ETH) Zurich, Switzerland.



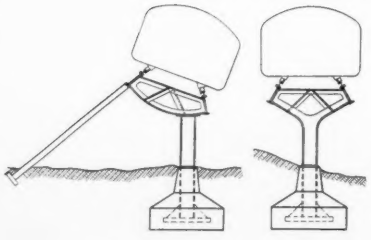


FIG. 1. Sketches show cross-sections of V-type track for elevated construction.

The overhead type of monorail system was found to be more costly because of the large eccentric loads and the wind pressure, which cause extremely high bending moments in the necessarily higher supporting structure so that much larger foundations are required.

Enclosed are two photographs of the model track and car of the V-type system. Wheels and rails were inclined to prevent derailing with high speed. Climb, acceleration, and deceleration were improved and the ride was found to be very smooth.

The system was tested on two railroad tracks on a 1 to 10 scale. Detail drawings of cars and elevated track were made. However the war prevented the execution of the project at that time. The drawings and test results should still be available at the Institute of Technology.

The cars were of lightweight, monocoque construction. Wheels were independently driven and inclined 35 deg towards the center line of the car. Rails were inclined 30 deg towards the center line. Standard rails were mounted with wedge-type blocks to the sleepers. In elevated construction, both rails were mounted on 1-ft I-beams, supported at 40-ft intervals.

Tests proved that speeds up to 300 miles per hour would be possible, since

the wheel rims are held under the inclined rails. The lightweight car construction, in combination with the inclined wheels, allowed more rapid acceleration and deceleration and therefore resulted in higher frequency and greater economy. Elevated, ground-level, and subway construction pose no problems, and all three systems can be interchanged freely. No costly elevated stations are necessary; stations can be at ground level. Furthermore the system has all the advantages of the overhead monorail system.

HARALD H. ZUR NIEDEN, M. ASCE
Consulting Engineer
Laguna Beach, Calif.

What's right with engineers

TO THE EDITOR: The article in the May issue entitled "What's Wrong with Engineering Education," by Herman L. Danforth, calls for a rebuttal stating "What's right with engineers" and "What sort of education makes the engineer right."

From the many criticisms of his imagined deficiencies in public and human relations, one would think that the engineer never gets married, owns a home, has a family, attends church, sees his children through school or participates in any of the other activities that make up the life of an American citizen today. We all know that engineers are not different in these things from other educational or professional groups. In fact, surveys of the after-college life of college graduates have shown that the graduate engineer has been commendable above the average. Considering that the large majority of engineers in the past have been salaried, it is probable that in relation to other salaried groups the engineer has actually been outstanding.

In recent years the number of engineers in private practice has increased many fold, and the salaried engineer has received greater recognition by corporations and government. This has resulted in greater public recognition of the engineer and in his increased participation in public affairs to such an extent that an impartial review today would show that little criticism is called for.

Let us ask ourselves what has been and should be the function of engineers as a class and how they should be trained to perform that function.

First and foremost the engineer has earned and should retain the reputation of being a doer, one who plans both the possible and the seemingly impossible and gets them both done. This statement is self-evident and surely needs no proof either within or without the profession. Other functions could be discussed but they seem to be secondary or to overlap.

How do we educate and train a doer? By doing, of course. When we have learned to do something ourselves we are then competent to supervise others in the accomplishment and to move up the ladder of supervision with increasing knowledge of how things are done and how to get them done. Is it conceivable that the average engineer could adequately supervise the making of drawings if he had never made a drawing; that he could supervise design if he had never made a computation; that he could lay out and supervise the construction of a power plant if he had never staked out a job or checked a boiler setting; that he could take the responsibility of operating a $100,000,000 chemical plant if he had not become familiar with such a plant by working with the repair gang or reading the instruments as the raw materials were mixed and separated into the finished products?

The philosophy of the article, "What's Wrong with Engineering Education" strikes at the very foundation of engineering thought and training. It would have you believe that the engineer can burst forth in full bloom from the classroom ready to solve all the problems of engineering, society, and government by the power of a mind trained by an engineering education which is largely not engineering at all. It would have you believe that bridges can be designed and built, power plants designed and put in operation, the wonders of chemistry and the atom put at our disposal solely by the functioning of a trained mind. Can we here subscribe to the philosophy that the making of stress and quantity calculations, working out chemical reactions and preparing heat balances is not engineering; that the making of design and construction drawings is not engineering; that the planning and supervision of construction is not engineering; that the operation and maintenance of the completed plant is not engineering; that all these things are the function of technicians and are not to be called or thought of as engineering?

In contrast to one of the illustrations in the above mentioned article, can you picture a Steinman or a Hardesty who had never himself worked at a drawing board; had never made many pages of computations to arrive at an economical and practical design; had never devised and rejected innumerable details for something as simple as a truss joint or as complicated as the construction and erection of a major river bridge? Can we substitute for the years of application to what has been called technical duties that made Steinman and Hardesty what they are, a four- or five-year study course taught to young men in their late teens and early twenties, young men of diverse backgrounds and intelligence, and little actual experience on which to base a judgment?

We believe that the college curriculum has been and will be right when it is both theoretical and practical; that so-called "culture" and "humanities" should be a reasonable part of the curriculum; that engineering drawing should be taught and taught well since it is the end product of many engineering groups and the starting point for all construction in building a modern world; that surveying should be taught as another of the honorable functions of the civil engineer. Moreover the college should take responsibility for seeing that there are diverse curricular and extracurricular group activities and that the student participates; that the student understands his education is intended to teach him the habit of work, original and orderly thinking, clear and fluent expression, and the attainment of fixed objectives. We believe that this background of theory, technical skills, and good habits will be combined in good time with the knowledge attained by experience on the job to give the young engineer an able and confident approach to the problem of getting the job done, be it planning on high or low levels, construction or operation. When he has established home and family, these lead him into community and social responsibilities which he must not shirk and in which he should follow or lead as the occasion, and his own talents and abilities, may dictate.

Let us recognize that one of the major functions of the engineering societies should be to keep the engineer reminded of his civic and social obligations. Let us never lose sight of the engineer as the doer who accomplishes his objectives because of his education and training. As he continues to merit the reputation of getting the job well done with consideration for the public, the client, and the employee, so will he be honored among men.

ROBERT B. YULE, M. ASCE
Yule, Sticklen, Jordan & McNee
Philadelphia, Pa.

Why are many graduates primarily technicians?

TO THE EDITOR: The article by Herman L. Danforth, M. ASCE, on "What's Wrong with Engineering Education" (May 1955) offers some interesting criticisms of an ever-present problem, and suggests some possible remedies.

The author points out that the engineering graduate cannot think in broad terms and lacks judgment in evaluating the various conditions to be met in a specific design. How can a young engineer develop sound judgment in appraising a problem without more experience than is possible in the condensed courses he receives in technical schools today? The solution of a half dozen problems in a given field will not give him "a feel" for a subject. The average student wants to learn set procedures which will enable him to go forth and earn a living in engineering.

He wants to have faith in these procedures. It has been my experience in trying to apply 25 years of practice to engineering education, that the student is rather disturbed at the thought that the slide-rule answer should perhaps be modified by judgment and a consideration of economic factors.

That our graduates are primarily technicians is not entirely the fault of the educational institutions or the students. Too many employers of engineering graduates want only detailers and men to carry out routine operations. At least one consulting engineering firm in the East has expressed a preference for graduates from other than big-name institutions because such graduates do not have illusions of grandeur, are not too ambitious, and are willing to sit on a drafting stool for many years if the pay is reasonably good. Many large industrial companies employ hundreds of technical graduates, but offer little opportunity to men who want to develop broad concepts and judgment. Too many bright, eager students are disillusioned by their so-called profession in the first few years of employment.

Mr. Danforth has suggested the establishment of two types of schools—one to train technicians and the other to educate engineers. This system actually exists in at least one Continental country, Portugal, and works out quite well. Unfortunately the choice between the two types of schools usually depends on the student's financial resources rather than on his ability. Such a system might not work well in this country because we like to create the illusion that every young man will develop into an engineer who can direct and plan great works. We would consider that such a school for technicians was creating a group of second-class engineers, and few would want to attend that type of school.

Educational institutions cannot be blamed entirely for student attitudes, which are often the result of their background. Many of them come from modest homes, and their parents have made sacrifices so that they can attend the university. The student wants to graduate and fit into a well paid position and perhaps pay off an indebtedness. Very few visualize themselves as great planners and leaders and actually very few have the capacity to be either. A well rounded curriculum and an inspired faculty can start some on the road to great things but the majority will never be anything but good, sound, dependable technicians, and there is certainly no disgrace in filling such a useful niche in society.

GORDON R. WILLIAMS, M. ASCE
Assoc. Prof. of Hydraulic Eng.
Mass. Inst. of Technology
Cambridge, Mass.

Recent graduate defends engineering education

TO THE EDITOR: May I, an "engineering graduate with a freshly engrossed sheepskin," give you my thoughts on the article, "What's Wrong With Engineering Education," by Herman L. Danforth in the May issue?

Mr. Danforth states in his first paragraph that our engineering colleges are doing a good job of training technicians but are failing to educate engineers. I expected him to follow with reasons why he felt that way and to supply data which would tend to prove he was correct. He failed to do either. The rest of the article gives definitions of training, education, and engineers, asks some questions of educators, and ends with the statement that the engineer's problems will be solved when he "emerges as a man of broadened interests and understanding and with the ability to express himself effectively."

One of the things I learned during my undergraduate days at the University of Nebraska was that the mere utterance of a statement does not prove the statement. To my mind, Mr. Danforth has written on a subject about which our educators should be, and no doubt are, very much concerned, but he has offered nothing to substantiate his stand on the matter.

He could have told us how many of our recent engineering graduates are being employed as "technicians" and how many meet his criteria for an engineer. He could have told us the number of engineers who have ability to perform complex engineering tasks but who are not given the opportunity to do so because they have not yet acquired the necessary experience. Let's examine these possibilities.

Is it true that employers are more concerned about the number of years of experience an applicant can claim than about his ability? Can our educators give our engineering students the required experience? If it were possible for our colleges to graduate students with "broadened interests and understanding," how would the employers recognize them? Assuming that such recognition were possible, would the employers follow through by giving those employees professional engineering tasks and higher salaries? I think the answer to the last question is negative and that answers to the other questions would also indicate that employers, not educators, have the greater responsibility of improving the quality of engineering performed by recent graduates.

It is my opinion, therefore, that even a survey showing the number of recent engineering graduates who are employed as "technicians" and as "engineers" would not indicate conclusively that there is anything wrong with engineering education. If engineering graduates are being employed in technicians' jobs, then it is strictly the fault of the employers. This country has a long list of eminent engineers who were educated in our engineering colleges, and that fact alone is sufficient to substantiate my belief that our colleges are doing a good job. I have no reason to believe that the chain will be broken by our recent graduates. Certainly it will take more evidence than that presented by Mr. Danforth to prove that our colleges need overhauling.

HARVEY W. HEADLEY, J.M. ASCE
Structural Engineer, Omaha Dist.
Corps of Engineers, U. S. Army
Omaha, Nebr.

Value of registration in public service

TO THE EDITOR: William Roy Glidden's article, "Employment Conditions and Leadership," in the April issue, provides food for thought and warrants the serious attention of every engineer interested in attaining professional status.

President Glidden's remarks concerning the desirability of registration for engineers in public service are particularly noteworthy. Certainly a position in public service does not automatically endow a person with engineering talents. The qualified engineer should have no fear of examination for registration. Public service engineers should welcome registration by examination to prove their competence and, at the same time, eliminate the incompetent who bear the title of engineer without possessing the qualifications of an engineer.

EDWARD W. LINGEL, J.M. ASCE
1st Lt., USAF

Does inferior triumph in engineering profession?

TO THE EDITOR: I am much concerned by the following statement made by our President, W. R. Glidden, and published in the April issue:

"I, for one, believe that the same principle that underlies Gresham's Law has universal application and therefore includes the engineering profession. The superior is being driven out by the inferior."

If this statement is a true representation of fact than it would appear to me that engineers owe a duty to the youngsters to see that they are so informed and also a duty to themselves to seek a less corrupt and corrupting occupation.

As this picture is entirely new to me I would like to hear the views of others on this matter.

R. B. MACFARLANE, M. ASCE
Macfarlane & Sadler
Consulting Engineers
Richmond, Va.

Collective bargaining seen as death to professional status

TO THE EDITOR: I was much interested in reading the discussion, "Why Oppose Collective Bargaining?" by C. W. Griffin in the May issue (p. 60).

I believe that Mr. Griffin has accurately described many of the problems and grievances of employed engineers. But I cannot go along with the assumption that collective bargaining is the proper solution to these problems and grievances. Even if it could be demonstrated that collective bargaining solves all the problems he mentions I still could not in conscience endorse it.

The very essence of a profession is the individual status of the professional man. He may be one of a team but he must be known as an individual, and appraised as an individual. The trouble with collective bargaining is that the individual is lumped with the mass of his fellows.

A collective bargaining unit is just as culpable, in the eyes of a true professional, as an employer who fails to recognize his individual engineering employees. Neither the bargaining unit nor the employer gives to the engineer his proper personal status.

It may well be that engineers will choose to adopt collective bargaining in order to solve their personal and economic problems. But when they do, the profession of engineering, as a profession, will vanish from the face of the earth.

In the meantime, I much prefer to go along with EJC and ASCE in their completely logical, but exceedingly difficult project for enhancing the true professional status of engineers.

As I see it, Mr. Griffin's concern about these matters does him credit, even if I cannot agree with his proposals.

C. J. FREUND
Dean, College of Eng.
University of Detroit

Detroit, Mich.

Prestressed concrete taught at IIT in 1951

TO THE EDITOR: Under the heading, "New in Education," the May issue carried the statement that the first course on prestressed concrete to be given and completed in the United States was at Brooklyn Polytechnic Institute.

In this connection I would like to mention that a course in this subject was given as postgraduate instruction at Illinois Institute of Technology from February 12 to June 7, 1951. Fifteen students completed this course.

A course in prestressed concrete is again being given here currently. This time the class consists of 33 graduate students and practicing engineers. We find that there is a great deal of interest in, and enthusiasm for, this subject here in Chicago.

E. I. FIESENHEISER, M. ASCE
Prof. and Director, Dept. of Civil Eng., Ill. Inst. of Tech.

Chicago, Ill.

AMERICAN SOCIETY OF CIVIL ENGINEERS

Hydraulics Division Meeting

University of California **Berkeley, Calif.** **August 24–26, 1955**

Host, San Francisco Section

REGISTRATION

Hotel Durant: 4:00 to 9:00 p.m. Tuesday, Aug. 23.

Dwinelle Hall, University of California: 9:00 a.m., Wed., Aug. 24.

First Session

WEDNESDAY MORNING
AUG. 24

10:00 a.m. **Dwinelle Hall**

General Session

Presiding: John K. Vennard, General Chairman, Berkeley meeting

10:00 Welcome by

HOWARD C. WOOD, President, San Francisco Section.

MORROUGH P. O'BRIEN, Dean of Engineering, Univ. of Calif., Berkeley, Calif.

10:45 The California Water Plan

WILLIAM L. BERRY, A.M. ASCE, Principal Hydraulic Engineer, Div. of Water Resources, Sacramento, Calif.

11:30 Discussion from the floor

Second Session

WEDNESDAY AFTERNOON
AUG. 24

1:30 p.m. **Dwinelle Hall**

Symposium on Statistics in Hydrology

Presiding: Joseph B. Tiffany, Jr., Vice Chairman, Hydraulics Division

1:30 Statistical Techniques in Engineering

GERALD J. LIEBERMAN, Asst. Prof. of Statistics and Industrial Eng., Stanford Univ., Stanford, Calif.

2:15 Evaluating Hydrologic Effects of Land Use Change

ALFRED J. COOPER, A.M. ASCE, Tennessee Valley Authority.

WILLARD M. SNYDER, A.M. ASCE, TVA, Knoxville, Tenn.

3:00 Frequency Analysis of Stream Flow Data

DAVID K. TODD, J.M. ASCE, Asst. Prof. of Civil Eng., Univ. of Calif., Berkeley, Calif.

3:45 Statistical Applications in Reservoir Operation

VICTOR A. KOELZER, A.M. ASCE, U.S. Bureau of Reclamation, Washington, D.C.

4:30 The Application of Statistical Methods to River Forecasting

DONALD W. KUEHL, J.M. ASCE, Hydrologist, River Forecast Center, U.S. Weather Bureau, Portland, Oreg.

Third Session

THURSDAY MORNING
AUG. 25

9:00 a.m. **Dwinelle Hall**

Floods

Presiding: Wallace M. Lansford, Member, Executive Committee, Hydraulics Division

9:00 Effects of Floods on Western Rail Transportation

DENMAN K. MCNEAR, J.M. ASCE, Asst. Engineer, Southern Pacific Railroad, Sacramento, Calif.

10:00 Economies of Self Protection of Highways against Flood Damage

JACOB C. YOUNG, M. ASCE, Traffic Engineer, State Div. of Highways, Sacramento, Calif.

11:00 Tolerable Flood Damage to Highway Bridges

R. ROBINSON ROWE, M. ASCE, Supervising Bridge Engineer, State Div. of Highways, Sacramento, Calif.

LUNCHEON HONORING FRED C. SCOBEY

12:15 p.m. **International House**

Presiding: Thornton J. Corwin, Jr., Chairman, Executive Committee, Hydraulics Division

Fourth Session

THURSDAY AFTERNOON AUG. 25

2:00 p.m. **Dwinelle Hall**

Design

Presiding: Harold M. Martin, Member, Executive Committee, Hydraulics Division

2:00 Non-Uniform Flow in Branches of Pipe Network Distribution Systems

R. CLIFFORD YOUNGQUIST, M. ASCE, Water Works Engineer, Dept. of Water and Power, City of Los Angeles, Calif.

WILLIAM H. KIRKGAARD, J.M. ASCE, Civil Engineering Asst., Dept. of Water and Power, City of Los Angeles, Calif.

2:45 The Hydraulics of Hollow Jet Valves as Determined by Field and Laboratory Tests

DALE M. LANCASTER, J.M. ASCE, Engineer, Public Works, U.S. Navy.

ROBERT B. DEXTER, Hydraulics Engineer, U.S. Bureau of Reclamation.

3:30 Sewer Flows in Flat Sewer Lines

HARRISON W. KRAMER, A.M. ASCE, Consulting Engineer, Carey and Kramer, Seattle, Wash.

4:15 Friction Measurements in Ten-Year-Old Apalachia Tunnel

REX A. ELDER, A.M. ASCE, Head, TVA Hydraulic Lab., Norris, Tenn.

Fifth Session

FRIDAY MORNING AUG. 26

9:00 a.m. **Dwinelle Hall**

Research

Presiding: George H. Hickox, Member, Executive Committee, Hydraulics Division

9:00 Status of Research in Shoreline Protection

JOSEPH M. CALDWELL, M. ASCE, Chief, Research Div., Beach Erosion Board, Washington, D.C.

10:00 Research Needs in Sediment Hydraulics

ENOS J. CARLSON, M. ASCE, Hydraulic Lab., U.S. Bureau of Reclamation.

CARL R. MILLER, J.M. ASCE, Hydrology Div., U.S. Bureau of Reclamation.

11:00 Liquid Jet Disintegration—A Review of Breakup Processes

JOHN DUNDERS, Northwest Technological Inst.

WALLIS S. HAMILTON, A.M. ASCE, Prof. of Civ. Eng., Northwestern Univ., Evanston, Ill.

Sixth Session

FRIDAY AFTERNOON AUG. 26

1:30 p.m.

Inspection Trip

Inspection of the Hydraulic Laboratories of the University of California on the Berkeley Campus and at the new Engineering Field Station at Richmond.

FIELD TRIPS

Visitors entering Northern California from the East can see many large hydraulic projects, completed or under construction. Cherry Valley Dam of the City of San Francisco is under construction and may be reached by a side trip from State Highway 120. Travelers on U. S. 40 or 50 can easily include Folsom Dam near Sacramento, under construction by the Corps of Engineers and the Bureau of Reclamation. Travelers from the north can include Shasta Dam, a major unit of the Central Valley Project. Hoover Dam may be seen when entering California from the southwest. Along the Feather River (U. S. 40A) the new hydro projects of the Pacific Gas and Electric Company may be visited.

Passes are required for the P. G. & E. projects. The following information will be needed for each named visitor: date of proposed visit and whether a.m. or p.m. Regarding the above, visitors should write to Mr. E. Neil Murphy, 100 San Pablo Ave., San Francisco 27, Calif., by August 7.

No organized field trips are planned, and it is assumed that all visitors will provide their own transportation. For travelers' information, the approximate driving times are (from Berkeley): to Cherry Valley, 6 hours; to P. G. & E. Feather River projects, 6 hours; to Folsom Dam, 3 hours.

HOUSING ACCOMMODATIONS

The Hotel Durant in Berkeley will be the official headquarters for the meeting, and a registration and information desk will be maintained in the lobby. Those planning to attend the meeting should make reservations directly with the hotel or motel of their choice as soon as possible. Please use the reservation blank provided on page 109 and mail to selected hotel or motel. The Hotel Durant and the Hotel Carlton are near each other and near the campus. The motels are farther away. International House is on the campus and a few blocks from the Hotel Durant.

Hotels in Berkeley

Rates for singles are for one person and rates for double bedrooms and twin bedrooms are for two people.

	HOTEL DURANT 2600 Durant Ave.	HOTEL CARLTON 2338 Telegraph Ave.
	Private Bath	*Private Bath*
Single	5.00– 7.00	4.00
Double	6.50– 9.00	5.00
Twin	6.50–11.00	7.00
	Share Bath	
Single	4.00– 5.00	
Double	5.75– 7.00	
Twin	6.00– 7.50	
	Without Bath	*Without Bath*
Single	3.50– 3.75	3.00
Double	4.75– 5.25	4.00
Twin	5.50– 6.50	5.00

Motels in Berkeley

All rooms have private bath. Rates for singles are for one person and rates for double bedrooms and twin bedrooms are for two people.

Berkeley Plaza Motel	1175 University Ave.
Motel Silva	1512 University Ave.
Campus Motel	1619 University Ave.

Single, 5.00; double, 6.00; twin, 7.00.

Campus Housing

There are a limited number of rooms available at International House. All rooms are single ($2.50) and without private bath; however,

bath facilities are in close proximity to the rooms.

Local Committee

Revoe C. Briggs, Wesley F. Getts, E. Neil Murphy, David K. Todd, John K. Vennard, *Chairman*

LADIES PROGRAM

A bus trip "down the peninsula" to Stanford University and Sunset Magazine is planned for Thursday, Aug. 25. Luncheon will be served at the Allied Arts Guild in Menlo Park. On the other days ladies may explore the Berkeley campus of the University of California and the shops of Berkeley and San Francisco. The Gray Line sightseeing trip through San Francisco is also recommended.

AMERICAN SOCIETY OF CIVIL ENGINEERS

Irrigation and Drainage Conference

Albany Hotel **Denver, Colo.** **Sept. 8–10, 1955**

Sponsored jointly by Irrigation and Drainage Division and Colorado Section

An extensive program has been planned for the Irrigation and Drainage Conference to be held in Denver, Colo., September 8–10, 1955. The Albany Hotel will be headquarters for the conference, which is sponsored jointly by the Irrigation and Drainage Division and the Colorado Section, both of ASCE.

Entertainment will be provided for the ladies and for the families, who are cordially invited to attend. True Western hospitality will reign supreme, and everyone is urged to take advantage of this opportunity for a splendid vacation at the close of the summer season. Indian Summer in the Rocky Mountain area is unsurpassed for beauty.

The following outstanding technical program has been arranged.

THURSDAY MORNING

SEPT. 8

8:00 Registration on Mezzanine Floor, Albany Hotel, $2.00. Obtain luncheon, dinner, and trip tickets at registration desk. Everyone is urged to register, regardless of arrival time.

9:45 Evaporation from Free Water Surfaces at High Altitudes

HARRY F. BLANEY, M. ASCE, Research Project Supervisor, Soil and Water Conservation Research Branch, U. S. Dept. of Agriculture.

10:30 The Colorado River Project Storage Requirements for Maximum Consumptive Use

J. R. RITER, Chief Development Engineer, U. S. Bureau of Reclamation.

11:15 Methods of Determining Consumptive Use

R. D. GOODRICH, M. ASCE, Chief Engineer, Upper Colorado River Commission.

Discussion

12:15 Men's Luncheon—Albany Hotel

THURSDAY AFTERNOON

SEPT. 8

2:30 Allocation of Costs on Multi-Purpose Water Development Projects

N. B. BENNETT, A.M. ASCE, Chief, Project Development Division, U. S. Bureau of Reclamation.

3:15 Evaluation of Direct and Indirect Benefits of Water Development Projects

EARL R. FOGARTY, Chief, Economic Resources Branch, U. S. Bureau of Reclamation.

4:00 Criteria for Determining the Economic Justification of Water Development Projects

JEWELL J. RASMUSSEN, Professor of Economics, University of Utah.

Discussion

FRIDAY MORNING

SEPT. 9

8:30 Importance of Measuring Irrigation Water

R. L. PARSHALL, A.M. ASCE, Fort Collins, Colo.

9:15 Experiences and Methods of Measuring Water on Small Irrigation Projects

FRANK MURPHY, Chief Hydrographer, State of Wyoming.

10:00 Methods and Devices Used to Measure Water in Irrigation Systems

CHARLES W. THOMAS, M. ASCE, Hydraulic Engineer, U. S. Bureau of Reclamation.

Discussion

FRIDAY AFTERNOON

SEPT. 9

2:00 Drainage Investigations in Western United States

WILLIAM W. DONNAN, A.M. ASCE, Research Specialist, Agriculture Research Service, U. S. Dept. of Agriculture, Fort Collins, Colo.

3:00 Panel Discussion of Drainage Problems and Their Solutions

CHARLES R. MAIERHOFER, Moderator; K. E. ANDERSON, GEORGE BRADSHAW, JOHN G. SUTTON, and E. W. ELLIOTT, all members of ASCE.

6:00 Social Hour

7:00 Dinner, Albany Hotel

Joint meeting with Colorado Section. Ladies are invited to attend the Social Hour and the dinner. Dress, informal.

SATURDAY

SEPT. 10

7:30 a.m. Chartered bus or auto trip to Colorado-Big Thompson Project

Includes spectacular trip across the famous Trail Ridge Road in Rocky Mountain National Park. Bring a warm wrap and spend the day.

Preregistration cards will be mailed shortly. S. MARK DAVIDSON, M. ASCE, 3225 Ash St., Denver, Colo., is Chairman of General Arrangements. Additional information may be obtained from him, from DEWEY S. WRIGHT, A.M. ASCE, Secretary-Treasurer of the Colorado Section, or from H. E. PRATER, M. ASCE, Secretary, Irrigation and Drainage Division.

SOCIETY NEWS

WE MET IN ST. LOUIS

The Jefferson Hotel in St. Louis rolled out its red carpet for the Summer Convention of the Society. There the St. Louis Section, under the guidance of President Clarence Ax, did a highly creditable job of coordinating the technical programs developed by ten of the Society's Technical Divisions. In all nearly 100 papers were contributed in 24 sessions spread over the week of June 14–17. The attendance of 776 was good, especially in view of competition from other meetings and commencement season claims.

The Convention was memorable also for a decision coming out of the meeting of the Board of Direction to restudy the whole subject of a site for the proposed new Engineering Societies Center Building (pages 74 and 75); for the nomination of Vice-President Enoch R. Needles as next year's President of the Society (page 75); and for the annual award of Society prizes for technical paper achievement.

Behind the scenes and at the beginning of each day during the Convention the St. Louis Section was host at breakfast to the 40 or more meeting chairmen and authors of papers to be presented during the day. Here William J. Hedley, chairman of the Technical Program Committee, checked on meeting chairmen and authors and their needed projection equipment. These breakfast conferences added much to the efficient presentation of the technical program, which featured subjects ranging from details of design and construction of the very large wind tunnels at Arnold Engineering Development Center at Tullahoma, Tenn., to the impact of the three years of drought beginning in 1952; from a discussion of what's wrong with civil engineering education to the stability of suspension bridges; from the place of toll roads in our expanded highway program to the use of geophysical and geochemical exploration for tunnel construction.

Local Section Conference

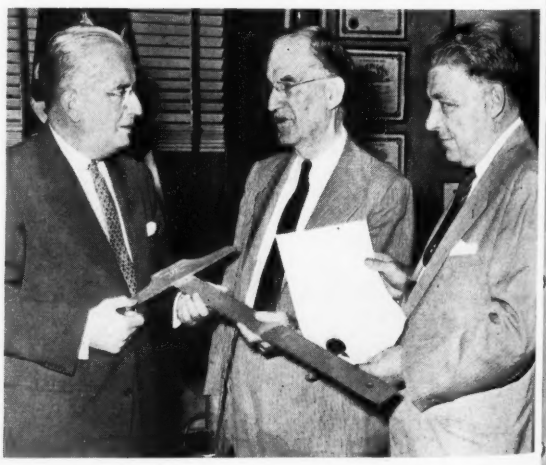
For two days at the outset of the Convention delegates from Local Sections in the St. Louis area exchanged ideas for improving the effectiveness of Local Sections in serving the needs of members of ASCE at the local level. For the first time each Section was authorized to name a second delegate to the Local Section Conference from among its Junior Members. Attendance at the four enthusiastic sessions was primarily for invited delegates but the attendance was enhanced by a number of other interested members who added fruitful comments about their own experiences in Local Section administration.

President Delivers Annual Address

President William R. Glidden's thought-provoking annual address featured the Wednesday morning "Welcome Session." In it he examined some of today's problems and made prophecies for the future in the light of history. Saying that "history and the reliable methods of science reveal the road ahead," Mr. Glidden pointed out that, "The idea of progress, the idea of unlimited advance is a comparatively new concept. We have become so accustomed to the expectation that the future will surpass the present and the past that we overlook the fact that prior to the Industrial Revolution, and the beginnings of modern science, the world was static . . ."

Almost any form of government, he believes, "will succeed when its citizens are honest and diligent. No government can long succeed, however exalted in conception, when its people individually or in organized pressure groups are selfish, dishonest, and ignorant. Until we have good people we will not have good government."

In readiness for the registration rush are (in usual order) Verne C. Hanna, chairman of Public Relations; Joseph W. Graves, chairman of Registration; Morris B. Landau, assistant manager, St. Louis Convention Bureau; and Brice R. Smith, general chairman of the Convention. In view at right Mayor Raymond R. Tucker presents proclamation and gold-plated tee-square to President W. R. Glidden, in lieu of the keys to the city. St. Louis Section President Clarence Ax (right) watches approvingly.



Mr. Glidden sees the development of bridge engineering to its present high state of perfection as illustrating "what can be done under no rule at all. The discovery and utilization of the basic mathematical and physical laws and processes have been entirely independent of governmental regulations. In science and engineering only the laws of nature govern. . . . What is true in science and engineering is true in all lines of human endeavor; progress is greatest when least hampered by regulation; discovery and advance are accelerated when there is greatest diversity of activity . . . .

"The possibilities inherent in the impending use of atomic power stagger the imagination," Mr. Glidden noted. However, he also sees atomic developments as one of the "many portents of the doom to come . . ."

"Breakdown of a civilization occurs when the creative minority, the leaders, lose their creative power—in short, when spiritual sterility sets in. And it may well be that the great challenge our society must meet, in order to survive, is its own materialism," Mr. Glidden concluded. His entire paper will be printed later in TRANSACTIONS.

Mayor Tucker Wednesday Luncheon Speaker

Welcome to the city began with a proclamation by Mayor Raymond R. Tucker declaring the period of the Convention to be Civil Engineers Week in St. Louis and by a ceremony in His Honor's office at which he presented to President Glidden, not the proverbial key to the city, but a handsome gold plated tee-square suitably engraved. Different, too, is the fact that Mayor Tucker is an engineer and former head of the department of mechanical engineering at Washington University, St. Louis.

With this background Mayor Tucker's welcoming address at the Convention luncheon, entitled, "The Engineer in Public Life," was well grounded in technical fact. A capital improvement bond issue of $110,639,000 had been overwhelmingly approved by St. Louis voters three scant weeks before he spoke. "One of the reasons for voter approval," he said, "was the fact that each item submitted to the public was previously studied, analyzed and actually recommended by respected engineers in this community."

The engineer, according to the mayor "has all the earmarks of effective, responsible citizenship—except one. In too many instances he lacks the dynamic conviction of his own importance and value as a citizen. . . . Engineers must be active which means more vocal in civic groups of all kinds. They should use their unique abilities and training to further assist the two-party system as developed in America. No good can be accomplished, in any field, by cynical inactivity." He closed by saying, "while you are here, it is my fervent hope that you will closely inspect this metropolitan area with a view toward selecting it as the site for the new headquarters of your own and the other engineering societies."

Session on Engineering Education

An examination of our profession, especially of the education of civil engineers, was the subject of a well attended general session sponsored by the Committee on Conditions of Practice. Prof. Weston Evans, chairman of the Society's Committee on Engineering Education, pointed out that 30 percent of the present curricula is devoted to civil engineering subjects. He stated that the increasing trend toward making curricula more general on the one hand and more scientific on the other has resulted in "less drawings, less surveying, less design, in fact less of everything that the young graduate would normally find useful immediately after graduation. In the undergraduate curricula engineering as an art has all but vanished—engineering science is receiving much greater emphasis." Professor Evans observed that there appears to be a widening gap between what the colleges turn out and what employers of civil engineers expect.

Dr. John B. Wilbur, head of the department of civil and sanitary engineering at MIT, spoke on the subject of "The Paradox of Professionalism in Engineering Education." The paradox is that "while emphasis on basic science and mathematics is essential, this very emphasis carries with it a nurturing of systematized thinking that may inhibit or even preclude the development of the judgment and the imagination that are essential to the highest expression of professionalism . . . It should be recognized that as soon as any area of knowledge becomes substantially systematized, it thereby becomes subprofessional in character—however complex it may be, and however important it may be as a partial base for professional operation. If a thing is systematized, it can be mechanized; or if it should not be economical to build a machine, it can be highly organized so as to become capable of inexpensive and subprofessional operation."

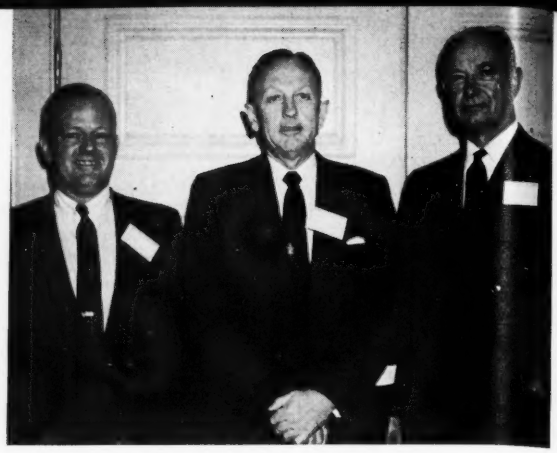
Speaking about the often-stated need for an authoritative appraisal of civil engineering education, Adolph Ackerman, consulting engineer of Madison, Wis., and chairman of the ASCE Task Committee on Engineering Education, pointed out that before intelligent recommendation concerning future plans for engineering education can be made "we must establish a realistic concept of the profession itself—the ultimate beneficiary of the planning." For instance we must know what kind of graduates our profession wants and what

In gay mood at the Show Boat dinner party, are Section President Clarence Ax, Mrs. Needles, Mrs. Ax, and Vice-President Enoch R. Needles, who is official nominee for President of ASCE in 1956.

Six-volume set of "Transactions" of 36th Annual Convention held in St. Louis (1904) —displayed at publication center—seems to interest T. J. Cambern (left) and R. R. Tipton (right).

With some Texas bucks Prof. I. W. Santry (left) tries to entice Clarence Ax to attend ASCE Convention in Dallas next February. Looking on are Joseph Graves, registration chairman, and General Chairman Brice Smith.

With a model of famous Eads Bridge in the background are (left to right) Clarence Ax, president of St. Louis Section; Francis Wai, vice-president of Hawaii Section; Brice R. Smith, general chairman of Convention; William H. Wachter, president of Hawaii Section; and William J. Hedley, chairman of Technical Program Committee. Session on Impact of Modern Business on Engineering Practice drew a large attendance and warm discussion. Participants are (right-hand photo) Herbert C. Gee who spoke on "Advertising by Professional Engineers"; ASCE Vice-President Mason G. Lockwood, who presided; and Raymond A. Hill, former Society Director, who presented the views on competitive bidding of his Committee on Professional Practice.



kind it should want. How long should the course be? What are the capabilities and shortcomings of our engineering colleges? How can we make a fair distinction between the mass production of technicians and the personalized development of professional men? What is the best plan for solving the current and future shortage of engineers? Why are so few engineers in policy-forming political positions? What reorganization is needed to strengthen our professional structure? How can desirable changes be accelerated?

These and other questions can be answered only after a comprehensive survey and analysis of the civil engineering profession and its educational problems "Such a survey would take at least a year," said Mr. Ackerman, "and it will call for a very substantial sum of money." Financial help is being solicited by the Task Committee, "Not only is financial help needed," he stated, "but every member owes a debt to his profession and this debt can, in part, be paid off by first coming to grips with the problems and by taking a sustained personal interest in the preparation of the next generation of our profession. You can start right now."

Task Force on Water Resources and Power

Because the report of the Hoover Commission on Water Resources and Power is not expected to be released for publication until late in June, the Task Force and Group Chairmen could report to the Convention in St. Louis only their personal views. This they did at a general session on Wednesday afternoon, June 15. Chairman Ben Moreell, Hon. M. ASCE, summed up the scope of the Task Force's work and its general personal conclusions; John Jirgal of Chicago, chairman of Task Group A, presented views on power generation and distribution including atomic energy; Leslie A. Miller, former governor of Wyoming and chairman of Task Group B, presented views on reclamation and water supply, including domestic and industrial supply, irrigation, pollution, recreational projects and drainage; W. W. Horner, Past-President ASCE and chairman of Task Group C, spoke on flood control, including water-retardation projects and upstream watershed treatment; and Carey H. Brown, M. ASCE, Rochester N.Y., chairman of Task Group D, explained the views of his group on improvements to navigation, including inland transportation and beach erosion.

Admiral Moreell's Task Force of 26 men includes fourteen engineers, six lawyers, two newspaper men, three present or former governors, four business executives, an accountant, and a consultant in utility economics and finance. Some members fall in more than one of these categories. Eleven of the Task Force members are members of ASCE, two are Past-Presidents, three others are former officers.

In contrast to the first Hoover Commission, whose scope of activity was limited to studies and recommendations concerning the then existing functions of government, the second and present Hoover Commission had the additional duty of making studies to determine whether existing governmental functions are being performed efficiently, whether they should be done at all, and if so, to what extent and in what manner. In the course of its work the Task Force held public hearings in San Francisco, Denver, New York, Chattanooga and Portland, Oreg.; listened to the statements and testimony of 261 witnesses, which when typed covered in excess of 5,000 typewritten pages. Two hundred projects were studied in detail. Every member of the Task Force was accorded complete freedom to state his own opinion on all matters under consideration. When printed, the Task Force Report to the Hoover Commission will consist of three volumes—1,780 pages in all.

Power—Mr. Jirgal reported that in 1933 the government owned and operated less than one percent of the total utility-plant capacity in the U.S. Twenty years later, in 1953, its proportion had increased to $12^1/_2$ percent, and by 1960 it will be about 16 percent. "At the end of 1953 all the federal generating plants and transmission lines had cost the taxpayers $2.3 billion," Mr. Jirgal said. "Upon completion of the federal plants now under construction and presently authorized these plants will have cost almost $10 billion. . . . It is obvious that federal power activities are big business."

He answered his question, "Is this federal power business being run economically and efficiently?" by stating that it appeared to the Group that the engineering and physical operations were in keeping with the best practices followed by the electric industry generally. "We were impressed with the competence of the present field supervisory forces with which we came in contact." But is the power generated at multi-purpose plants being sold for what it is fairly worth? He believed not. "Congress in effect acts as a Board of Directors of multi-billion-dollar power business without having established a definite policy as to the price to be charged for the products of the business or ever seeing to it that the prices charged cover fully all the costs incurred in their production. Federal power operations to June 30, 1953, failed to recover these costs by over $330 million. This deficiency was made up by the taxpayers."

He recommends that as a "first step the full earning capacity of the existing federal power properties be brought about by increasing rates so that they will yield a fair return on the investment." Next, he believes "the federal government should as soon as feasible withdraw from this field as based on present energy sources—coal, oil, gas, falling water or atomic energy—and refrain from entering it.

Water—Governor Miller told the Convention, "You know far better than the average audience that with a steadily growing population and with increased industrial demands it is imperative that we give immediate and constructive attention to conserving our limited supply of water and using it, in all aspects, to the utmost advantage." He pointed out that there does not exist any overall federal water policy to do this. "The present division of responsibility for water resource development among a number of governmental agencies leads to overlapping of authority with jurisdictional disputes and to water resource developments in which each agency has carefully hacked out a niche for itself in the project plan." His Task Group considers it essential, with multiple-agency responsibilities, that conflicts among them be resolved by the establishment of a Board of Coordination and Review responsible to the President and Congress. It would coordinate the planning, evaluation of feasibility, and application of uniform cost-benefit ratios for water resources developments by federal agencies, and by state, interstate and local agencies participating in works having partial federal responsibilities. It would review authorized projects for compliance with approved plans, cost and performance. It would review presently authorized projects, and if construction has not been started recommend to the President and Congress which should be deauthorized.

Flood Damage Abatement—Past-President Horner reported that, "Floods take a tremendous annual toll of lives and property destruction, and the Nation has poured vast sums of money into measures to prevent their recurrence or lessen their harmful effects." Beginning with the Flood Control Act of 1936, but including the Lower Mississippi Project, the Congress has authorized the Corps of Engineers to proceed with a flood control program involving 1,033 projects with an estimated cost of over $11 billion. Of these 423 had been completed or were under construction at the beginning of 1955 with an up-to-date cost estimate of $5.8 billion; and 390 more projects are classified by the Chief of Engineers as active and ready for construction at a cost of about $3.5 billion. The rest are inactive or under further study. If Congress continues appropriations at about the current rate it will take something like 12 years for the Corps of Engineers to complete the active program.

Certain upstream work was assigned in 1954 to the Department of Agriculture under the Watershed Protection and Flood Prevention Act. Mr. Horner's Group estimated that this upstream work could involve an ultimate capital expenditure of about $17 billion. "If these sums are transformed into values covering interest and amortization, the total sum approaches $65 billion, the equivalent of nearly half the national debt. Even when discounted heavily for units which cannot be economically justified "there is still a potential expenditure of the order of $50 billion.

"It is clear that we have a flood control program involving tremendous cost, paid for almost entirely by the federal taxpayers, with the actual beneficiaries making no more than token contributions (5.8 percent and less), even though the beneficiaries are today capable financially of paying substantial parts of the cost."

Mr. Horner concluded, "In my opinion, the national policy should be restated to restrict the program to major projects of national significance, and to require the direct beneficiary to agree to pay a substantial part of the cost."

Navigation—Mr. Brown, speaking about navigation projects, stated that it was unreasonable to expect the American public to put out vast sums each year to provide free inland waterways to be used by a limited number of shippers and carriers for their own profit without any reimbursement to the federal government. "Already it has spent more than $4.5 billion to improve, operate, and maintain its navigation system, including 286 coastal harbors, 131 Great Lakes harbors and channels, the intracoastal canals, and numerous rivers. Navigable waterways, as "navigable" is used in legal parlance, are estimated to be 60,000 miles in length. Of these, 28,400 miles have been authorized for improvement and 22,500 miles have actually been improved for navigation. The current estimate of the future cost of completing authorized projects exceeds an additional $4.5 billion.

"One reason navigation interests are able to get so much money for undeserving projects" Mr. Brown stated, "is that public power advocates and those favoring flood control seek to charge off to navigation substantial portions of the costs of such projects."

Adequate user charges, he said, would go a long way to correct most of these unsatisfactory conditions. User charges could be levied as a license fee for each carrier using the waterways; or as an excise tax based on a percentage of shipping cost; or as a toll for the use of waterways, locks and harbors. He concluded that, "a program consistent with the best interests of all the people cannot be sustained until projects are subjected to analysis by an independent agency endowed with broad national vision and inspired by a determination to place the general welfare above claims of subsidy-seeking groups and above the ambitions of any federal agency."

At luncheon sponsored by Construction Division's Pipeline Committee Presiding Officer W. W. Studdert introduces Rear-Admiral John R. Perry, chief of Navy Bureau of Yards and Docks, who spoke on "Defense Pipelines in Spain."

Rich Technical Program

It is impossible to give even a bird's-eye view of the 100 papers making up the technical program. Three of them—"Design for Interstate Highways," by Joseph Barnett, M. ASCE, chief of the Urban Highway Branch of the Bureau of Public Roads; "Locating Expressways in the St. Louis Area," by Meyer Abelman, urban engineer for the Missouri State Highway Commission; and "Structural Features of the St. Louis Airport Building," by William Becker, M. ASCE, St. Louis consultant—are published in this issue. Others will be scheduled for subsequent issues, and some will appear as Proceedings Papers.

Sessions sponsored by the Construction Division's Pipeline Committee proved very popular. One youthful speaker—Robert R. Herring, vice-president of the Pacific Northwest Pipeline Corp., Houston Tex.—aroused much interest with a talk on the Pacific Northwest Pipelines Project, which he aided in establishing. Departing from his prepared paper, Mr. Herring made a dramatic story of the financing and building of the tremendous project. Some four years in the building, the line carries natural gas all the way from Texas to the Northwest. It was financed entirely by private capital.

Decrying the theory that government bureaucracy is invading every phase of American life today, Mr. Herring said, "I

cannot speak from personal knowledge of other major industries today, but I can speak for the natural gas industry and more particularly of our example. Our industry is now the sixth largest in the United States, furnishing approximately 25 percent of the total energy requirements of home, commerce, and industry. In total pipeline miles we now exceed railroad trackage in this country by more than 75,000 miles. Much of this tremendous growth has taken place in the past twelve years at a time when this so-called bureaucracy was supposedly strongest. Nonetheless, the investment of capital funds for this growth, requiring nearly $5 billion, has all come from private sources. There were no subsidies, no financing guarantees—just good businessmen with sound engineering advice doing a private enterprise job such as many others who have made this country great."

Hydraulics and Waterways Division sessions on droughts and their twin disaster, floods, in the area bounded by the two Kansas Cities received much attention in the local press. Brig. Gen. Keith R. Barney, director of installations, Office of the Deputy Chief of Staff for Logistics, said that Kansas City flood crests must be reduced 40 percent to avert a repetition of the 1951 Kansas River flood disaster. Improved flood-warning methods, including radar, an electronic routing machine, and cooperation of radio amateurs, are factors contributing to the decision of industry to remain in the lowlands, General Barney said.

Dwight F. Metzler, chief engineer of the Kansas State Board of Health, warned that the persistent Kansas drought, starting in 1952 and continuing into 1955, may last several more years. He stated that Kansas must spend $118,000,000 in the next twenty years for expansion of water supply.

Committee Personnel

All meeting arrangements were under the general chairmanship of Brice R. Smith. Ladies activities were in the hands of Co-chairmen Mrs. William S. Hedley and Mrs. Brice R. Smith.

St. Louis Board Meeting Actions Briefed

Engineering Societies Center Building

After considering the April reports of the Committee of Five Presidents—a majority and a minority report—the Board recommended the formation of a fifteen-man Joint Task Committee to make further investigations and to recommend a site for the Engineering Societies Center Building. Details are to be found on another page.

St. Louis Offers Site

A site on the mall near the Union Station in downtown St. Louis was made available to the Engineering Societies for their permanent headquarters should they remove from New York. This is in addition to sites offered in other cities.

Technical Division Journals Authorized

Beginning with January 1956, the Proceedings papers of each Technical Division, now issued as Separates, are to be bound together and issued at convenient intervals. Members enrolled in Divisions will receive these Technical Division Journals automatically. Separate papers may be ordered by members as at present to an annual total of 100, in addition to the Journal, both free. This simple modification of the present procedure is expected to make Proceedings more useful and to yield substantial savings in printing and postage.

Portland in 1958

The Board accepted the invitation of the Oregon Section to hold the June 1958 meeting in Portland.

Certification of Sanitary Engineers

Approval was given by the Board to the incorporation of the American Sanitary Engineering Intersociety Board to certify sanitary engineers. The Board appropriated $7,500 as a loan, without interest, to the Joint Committee for the Advancement of Sanitary Engineering to finance initial steps in the incorporation and certification, and authorized use of desk space at ASCE headquarters for this purpose. The Joint Committee consists of three representatives each from ASCE, APHA, ASEE, AWWA, and FSIWA.

Membership of Society Grows

The Executive Secretary reported to the Board that no significant increase in withdrawals, or resignations has occurred as a result of the increase in Society dues. Membership is expected to pass 39,000 by the end of 1955.

Comprehensive Study of Civil Engineering Education

The Board approved the plan of the Task Committee on Engineering Education for conducting and financing a comprehensive survey and analysis of the civil engineering profession and its educational problems. It is expected that at least a year will be required for the survey. Substantial financial assistance from one of the foundations is hoped for.

Group Disability Plan Under Review

A task committee was appointed to review the group accident and health plan currently available to members of the Society.

J. Waldo Smith Fellowship

Under a proposal by Cornell University a grant of $1,000, plus not more than $400 for equipment, was granted to Peter L. Monkmeyer, of the Hydraulics Department, Cornell University, to study a new type of flow-metering device.

Freeman Fund Award

The Freeman Fund Award for 1955 was granted to Walter J. Tudor, J. M. ASCE, marine engineer, Bureau of Ships, U. S. Navy. He will study the phenomenon of the standing wave aft of moving ships. The grant is for $1,200 plus up to $300 for unusual equipment and instruments.

Prize Winners Announced

Winners of prizes and awards for papers in Vol. 119 of TRANSACTIONS—announced during the Board meeting—are listed elsewhere in "Society News."

Two Sections Establish New Branches

Acting on the recommendation of the Committee on Local Sections, the Board authorized the Nebraska Section to establish a new Southwest Branch, and the Texas Section to establish a San Jacinto Branch.

Local Section Allotments

Clarifying action taken at its October 1954 meeting, the Board voted specifically to change the individual-member allotment to Local Sections from $1.00 to $2.00.

Honorary Members Elected

Four members of the Society were elected to honorary membership. Upon their acceptance, announcement of their names will be made.

E. R. Needles Nominated as President of ASCE

Enoch R. Needles, senior partner in the firm of Howard, Needles, Tammen & Bergendoff of Kansas City, Mo., and New York, was nominated for President of ASCE by the Board of Direction at its St. Louis meeting. The nomination will be confirmed later by letter ballot of the membership, with installation of the new President in October at the Society's Annual Convention in New York.

Mr. Needles, a former Director and now Vice-President of the Society, is a past-president of the American Institute of Consulting Engineers and the American Road Builders Association. He was a colonel in the Corps of Engineers in World War II, receiving the Legion of Merit. His firm has been engaged in design, construction, and development of many of the nation's important bridge, expressway, and turnpike projects. Mr. Needles' home is in Summit, N.J.

ENOCH R. NEEDLES
Nominee for President

New Actions Taken on E. S. Center Building Project

At its St. Louis meeting the Board of Direction of ASCE recommended the expansion of the Committee of Five Presidents, which has been advising the Boards of the five engineering societies concerning the location of the proposed new headquarters. The Board suggested that each society add two representatives to the existing committee and that the Special Joint Task Committee thus formed be charged with the duty of recommending a specific site. Voting would be by each Society's representatives as a unit.

Before making a specific recommendation the Special Committee—whose formation must also be authorized by ASME, AIME, AIEE, and AIChE—would be empowered to engage independent professional consultants to investigate the problem and a paid secretary. A jointly authorized appropriation of $75,000 was recommended to finance the study. The findings and recommendations of the Special Committee would be based on its review of the majority and minority reports of the Committee of Five Presidents, dated in April, and upon its own comprehensive additional study of feasible locations.

The Board considered the offer of Dr. Kelly's Group (see below), and through the Executive Secretary cordially thanked them for their constructive interest and support.

Group Offers to Raise Funds

A new development in the picture is an offer by a group of 21 members of prominent academic and industrial organizations, headed by Dr. Marvin J. Kelly, president, Bell Telephone Laboratories, Inc., New York. A letter dated June 8—signed by Dr. Kelly's group and addressed to UET and the five engineering societies—stated that the long-range interests of the Societies in serving their profession and the nation should be controlling in the choice of location, and that the matter of local contributions should be secondary. "If a choice is made on this broadgage basis," the letter stated, "a group of the undersigned will organize a large national committee, representing all sections, all technologies in your Societies, and a variety of industries, to conduct a nationwide drive for funds. We will continue the effort until the required sum is available, which we understand is approximately $2.5 million." Some of the signers previously had indicated preference for one city or another, but they agreed that their personal preferences should be submerged in favor of a choice on a national rather than a local basis. The group suggested that a competent management or engineering firm be employed to make examinations and to coordinate and evaluate present studies before the final choice is made, and said that some of the group would underwrite this cost.

Miners Accept Offer

The Board of Directors of the AIME, at its meeting on June 15, expressed appreciation to Dr. Kelly for the proposal of June 8 and voted to take advantage of the offer. Their action on the Pittsburgh proposal was deferred.

Mechanicals Favor Restudy

The Council of ASME, which met on June 20, took action similar to that taken by the ASCE Board of Direction described above. The action authorized the enlargement of the Committee of Five Presidents to become a Joint Task Committee of 20 and to include UET. In addition, ASME asked the Joint Task Committee to seek extension of the time limit on the offer from Pittsburgh to March 1, 1956; to take advantage of the offer from Dr. Kelly's group; and to report simultaneously to the governing boards of the five societies promptly, but not later than January 1, 1956.

St. Louis Site Offered

St. Louis has offered a site for the Engineering Societies Center Building on the Mall at Aloe Plaza near the Union Station. Mayor Raymond R. Tucker of St. Louis, himself an engineer and former head of the Department of Mechanical Engineering at Washington University, told the ASCE Board, "We believe St. Louis provides an excellent location—geographically, industrially, educationally and scientifically." St. Louis Chamber of Commerce and Civic Progress, Inc., joined Mayor Tucker in the invitation to the Societies to relocate in St. Louis.

Engineering Foundation Makes 26 Research Grants

Engineering research will be advanced on a wide front next year with grants made available by Engineering Foundation. At its recent annual meeting in New York the Foundation approved applications totaling $61,850 for the 1955–1956 fiscal year. In a number of cases the grant is contingent upon the project's being able to raise outside support.

The grants will further twenty-six projects being carried out in university laboratories all over the country under sponsorship of the major engineering societies. The projects range from column research, which has been under way long enough to give definite promise of safer and cheaper structures, to a new research program for predicting disastrous storm surges in time to prevent serious loss of life.

Three grants of $1,000 each have been made to projects under sponsorship of

the ASCE—the Column Research Council, the Research Council on Riveted and Bolted Structural Joints, and the Reinforced Concrete Research Council—all without contingency. An ASCE-supported project on Techniques for Forecasting Waves will receive $5,000 contingent upon outside support of $15,000, and another civil engineering study on Evaluation of Alloy Steels for Fatigue Resistance in Structures will receive $2,500 contingent upon raising $6,500 outside support.

Other interesting allocations include three grants to independent projects—a project on Prevention of Corrosion of Water Pipes, the Building Research Advisory Board, and the Council on Wave Research. A Fluid Meters program of the ASME, which receives $1,000, is one of the oldest Foundation projects that is still active, having received Foundation support off and on since 1927.

Structural Dynamics Committee Plans Agenda

Preparation of a report on protective construction will be a major objective of next year's program of the Structural Dynamics Committee of the Engineering Mechanics Division. This decision was reached at a meeting of the committee held in Chicago on May 26. The report will aim to provide a more realistic approach to the problem and to clarify the basic principles of shock loading and protective construction. It will include study of such associated problems as radiation and fall-out. The committee is tentatively outlining a symposium on protective construction for the Society's Annual Convention next fall.

Prof. Nathan M. Newmark is chairman of the Structural Dynamics Committee.

Plans for EJC Nuclear Congress Take Shape

Some 300 nuclear authorities will reveal the latest "Atoms for Peace" progress in a huge parley to be held in Cleveland, December 12 through 16. Representatives, American and foreign, of business and technical societies, universities, government bureaus, and major industrial corporations will present papers in fifty sessions covering practically every phase of peacetime uses of atomic energy and its by-products at the Nuclear Engineering and Science Congress announced early this year.

Engineers Joint Council is coordinating the arrangements for the Congress under the leadership of its president, Thorndike Saville, dean of the New York University College of Engineering.

Concurrent with the congress there will be an exposition of new equipment and materials. The Atomic Exposition is sponsored by the American Institute of Chemical Engineers and headed by Prof. Barnett F. Dodge, of Yale University. Information from exhibitors reveals that a great deal of special equipment developed for peacetime uses of the atom will get its first public showing at Cleveland.

Reactor models of the latest design will be shown in the exposition. Several of these are still undergoing last-minute design changes and will be completed only a short time before the Atomic Show opens on December 10.

To handle the "hot" materials encountered in atomic installations, specially designed handling equipment capable of being remotely operated with great accuracy is being developed. These remote "mechanical hands" and their accompanying controls will be in operation at the show. Closed circuit television, a vital accessory to many of these installations will be another feature. Since many of the conventional materials do not have the properties essential for use in radioactive installations, newly developed alloys and materials possessing unusual properties will get a lot of attention.

ASCE Prizes and Awards Are Announced by Board

On recommendation of the Society's Committee on Prizes, the Board of Direction at its St. Louis meeting, approved the following awards and prizes for papers published in Volume 119 of TRANSACTIONS. Presentation will be made at ceremonies held during the Annual Convention in New York in October. Further details, together with brief biographies, will appear in a later issue of CIVIL ENGINEERING.

Norman Medal

KARL TERZAGHI, Hon. M. ASCE, for Paper, "Anchored Bulkheads."

J. James R. Croes Medal

JOHN S. MCNOWN, M. ASCE, for Paper, "Mechanics of Manifold Flow."

Thomas Fitch Rowland Prize

MAURICE N. QUADE, M. ASCE, for Paper, "Special Design Features of the Yorktown Bridge."

James Laurie Prize

JOSEPH N. BRADLEY, M. ASCE, for Paper, "Rating Curves for Flow Over Drum Gates."

Arthur M. Wellington Prize

RAYMOND J. IVY, A.M. ASCE, T. Y. LIN, M. ASCE, STEWART MITCHELL, M. ASCE, N. C. RAAB, M. ASCE, V. J. RICHEY, A.M. ASCE, and C. F. SCHEFFEY, J.M. ASCE, for paper, "Live Loading for Long-Span Highway Bridges."

Collingwood Prize for Juniors

WILLIAM J. BAUER, J. M. ASCE, for Paper, "Turbulent Boundary Layer on Steep Slopes."

On recommendation of the Technical Division Prize Committees, the Board approved the following awards:

Rudolph Hering Medal

RUSSELL G. LUDWIG, A.M. ASCE, HARVEY F. LUDWIG, M. ASCE, and W. F. LANGELIER for Paper, "Flocculation Phenomena in Turbid Water Clarification."

Leon S. Moisseiff Award

JOHN M. BIGGS, A.M. ASCE, for Paper, "Wind Loads on Truss Bridges."

James W. Rickey Medal

EDGAR S. HARRISON, M. ASCE, and C. E. KINDSVATER, M. ASCE, for Paper, "Dam Modifications Checked by Hydraulic Models."

J. C. Stevens Award

MARION R. CARSTENS, A.M. ASCE, for Discussion of Paper, "Mechanics of Manifold Flow."

Karl Emil Hilgard Prize

JAMES M. ROBERTSON, M. ASCE, and DONALD ROSS, for Paper, "Effect of Entrance Conditions on Diffuser Flow."

Construction Engineering Prize

JOHN A. DOMINY, M. ASCE, HENON PEARCE, and C. C. ZOLLMAN, A.M. ASCE, for paper in August 1954 issue of CIVIL ENGINEERING, "Fast Precasting Schedule for Record-Size Marine Corps Warehouses."

ASCE MEMBERSHIP AS OF JUNE 9, 1955

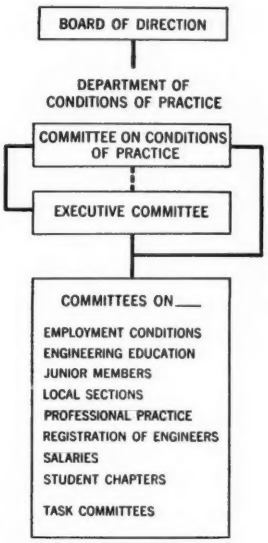
Members	8,970
Associate Members	11,496
Junior Members	17,968
Affiliates	70
Honorary Members	39
Total	38,543
(June 9, 1954	37,478)

ASCE Administrative Structure—Department of Conditions of Practice

As promised in the June issue (page 67), the organization of the Department of Conditions of Practice—one of the two principal administrative branches of the Society—is depicted here. The set-up of the other branch, the Department of Technical Activities, was similarly shown in the June issue. Mason Lockwood, as Junior Vice-President, is chairman of the Committee on Conditions of Practice.

Both the Committee on Conditions of Practice and the Technical Procedure Committee (one of two branches of the Department of Technical Activities) will meet in Milwaukee, Wis., on August 6 and 7 during a meeting of the District 7 Council (see below).

A lantern slide lecture giving a comprehensive picture of the whole structure of the Society has been prepared at the request of the Board of Direction, and a set of slides will be loaned upon request to the Executive Secretary as the basis for talks at Local Section and Student Chapter meetings.



Mason Lockwood
Chairman

Charles Yoder
Employment Conditions

Weston Evans
Engineering Education

Robert A. Marr
Junior Members

C. E. Drummond
Local Sections

Raymond A. Hill
Professional Practice

Robert E. Stiemke
Registration of Engineers

Robert J. Ellison
Salaries

Leo C. Novak
Student Chapters

District 7 Conference to Be Held in Milwaukee

Arrangements for the District 7 Conference, to be held in Milwaukee, Wis., August 5 and 6, are being completed by the Wisconsin Section, which will be host to the gathering. The Hotel Pfister will be meeting headquarters.

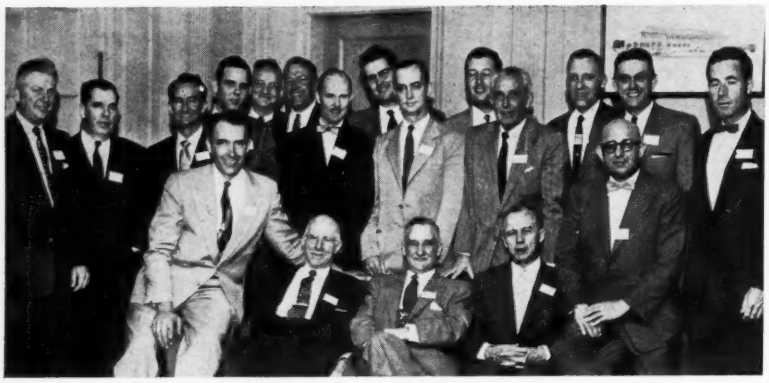
General topic of the technical session scheduled for Friday morning, August 5, will be Dams and Water Power, the speakers to be announced later. President Glidden, featured speaker at the Friday luncheon, will talk on "Private Engineering Practice and Public Works." Friday afternoon will be devoted to "Expressway and Toll Road Problems." Henry Wildschut will cover Milwaukee County expressways, C. K. Alexander, the Wisconsin Turnpike, and E. L. High, the Interstate System.

A baseball game between the Milwaukee Braves and Pittsburgh Pirates is the big entertainment on the agenda for Friday evening. Earlier there will be a tour of the Schlitz Brewery and dinner at the Schlitz Country Club.

In a Saturday morning general session on "Sanitary and Storm Sewer Design," Bernal H. Swab, chairman of the Sanitary Engineering Division's Committee on Preparation of a Manual of Practice on Sanitary and Storm Sewer Design and Construction, will speak on committee problems arising in preparation of a Manual of Practice. Two other members of the committee—H. S. Smith and R. R. Kennedy, vice-chairman—will discuss "Quantity of Storm Water as Related to Storm Sewer Design" and "Loads on Pipe." Francis M. Dawson, Director of the Society and dean of the University of Iowa College of Engineering, will address the Saturday luncheon on "Bidding and Advertising." The meeting will then adjourn in favor of an afternoon of interesting inspection trips.

Old Issue Wins Prize for E.S. Library

Ralph Phelps (right), director of the Engineering Societies Library, receives $500 first prize from George T. Hook, publisher of "Iron Age" magazine, for submitting oldest issue of the magazine in back-issue contest. Looking on is Tom Campbell, editor of "Iron Age." Winning issue was dated January 2, 1873. Second prize of $100 was won by the Schumacher-Kelly Co., Inc., of Freehold, N.J., with a June 17, 1875, issue. "Iron Age," the nation's top metal-working weekly, is celebrating its one-hundredth anniversary this year. The E.S. Library will use the prize money for furthering within the profession knowledge of the Library's needs and the services it offers.



Nashville Section is host here to two-day meeting of District 10 Council. Photo shows (seated, left to right) Buford Winn, Council chairman; former ASCE Director James A. Higgs; Frank L. Weaver, Vice-President, Zone II; Graham P. Willoughby, Director, District 10; and Albert E. Johnson, former Council chairman. Standing, in same order, are James F. Shivler, official Florida Section delegate; Wilbur Sensing, Nashville; Lewis S. Shields, Florida Section; Tom Lee, secretary-treasurer, Nashville Section; Paul C. Klyce, Tennessee Valley Section; Jack McElrath, president of Nashville Section; Raymond E. Strickland, official Alabama Section delegate; Donald W. Newton, Tennessee Valley Section; John Voorhees, Tennessee Valley Section delegate; John D. Buckley, Miami Section delegate; Roy J. Morton, Tennessee Valley Section; Harry J. Blazek, Nashville Section delegate; Hugh B. Henry, Tennessee Valley Section; and Ralph E. Fadum, North Carolina Section delegate. Vice-President Weaver gave a leading talk on "Aspects of the Studies of the Task Force on Water Resources and Power—Second Hoover Commission."

Coming Events

Indiana—Joint meeting with the Northwestern Sub-Section at the Gary-Hobart Water Corp., Gary, Ind., July 16. Tour of Filtration Plant, dinner at the Hotel Gary at 6:30, and afternoon and evening talks at the Hotel Gary.

Maine—Joint meeting with the New Hampshire Branch—field inspection of new Portsmouth Air Force Base, August 27.

Northeastern—Three summer luncheons with short talks at the Boston City Club, 14 Court Square, July 20, August 17 and September 21, at 12 noon. Reservations must be made the day before (price $1.25).

San Francisco—Section will be host to a Hydraulics Division Convention, August 24–26 (program on page 67).

South Carolina—Summer meeting with the North Carolina and South Carolina Societies of Engineers at the George Vanderbilt Hotel, Asheville, N.C., August 4–6.

Wisconsin—Host to District 7 Conference at the Pfister Hotel, Milwaukee, August 5 and 6 (item on page 77).

Lowell E. Gregg, chairman of District 9 Council, presents the Council's Daniel V. Terrell Award to Baxter W. Napier, Jr., J.M. ASCE, of Cincinnati Section, at banquet climaxing the Council's recent annual convention. Mr. Napier's prize-winning paper on "Unionization and the Young Engineer" will be published in "Civil Engineering." It was judged best of four presented by the Sections. All-day Council meeting was held at Purdue University, with the Indiana Section and the Student Chapters at Purdue, Rose Polytechnic Institute, and Notre Dame University as hosts. President Glidden spoke.

Scheduled ASCE Conventions

NEW YORK CONVENTION
New York, N. Y.
Hotel Statler
October 24–28, 1955

DALLAS CONVENTION
Dallas, Tex.
Hotel Baker
February 13–17, 1956

KNOXVILLE CONVENTION
Knoxville, Tenn.
University of Tennessee
June 4–8, 1956

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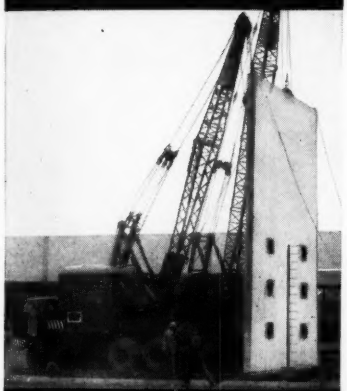

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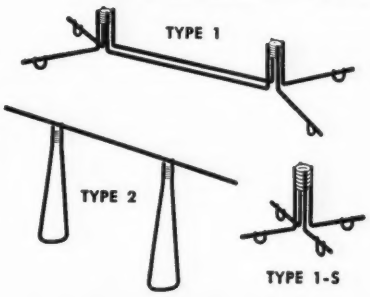

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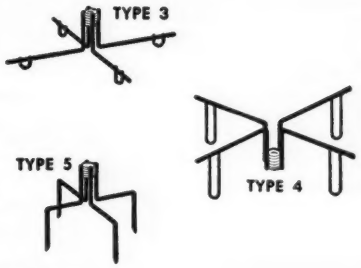
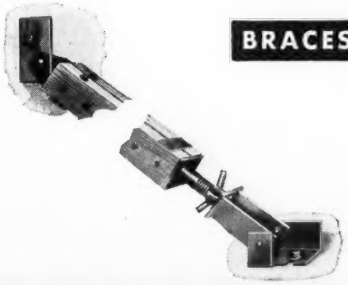


BRACES



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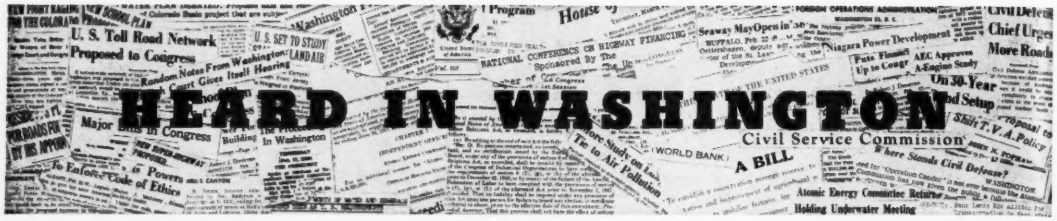


JOSEPH H. EHLERS, M. ASCE — **Field Representative ASCE**

Some bills of interest to the engineering profession are making reasonable headway in Congress. A progress report is a venturesome undertaking in the present state of confused fluidity.

Attempts are being made to reverse some important committee reports on the floor. The following random outline of the situation includes some decisions which may not stand up as final.

S. 890, a bill to revise and extend the **Water Pollution Act** of 1948, has been reported favorably by the Senate Public Works Committee in amended form. State officers contended among other things that the proposed water-quantity standards should not be used as a basis for federal enforcement and that federal enforcement in interstate situations should be contingent on a request from an affected state. Amendments relate to these points.

A bill for the control of **air pollution** (S. 928) has passed the Senate and is being considered in the House Commerce Committee. Research would be undertaken and an Advisory Board set up in the Public Health Service.

On July 1 the Public Health Service will take over the operation of the **hospital and health facilities of the Bureau of Indian Affairs** in accordance with the provisions of P.L. 568 of the 83rd Congress.

The **Public Health Service** will hold a brief summer training session for its commissioned reserve engineers in connection with training in emergency housing rehabilitation. There will also be a summer program for the utilization of engineer reservists as consultants in which about 20 will participate—mostly sanitary engineers of university faculties.

The **Upper Colorado River** bill which passed the Senate has been approved by the Irrigation and Reclamation Subcommittee of the House Interior Committee but with the controversial Echo Park Dam excluded.

Hearings are under way on bills to provide for the use of the federal share of **Niagara River waters** available for power under the 1950 Treaty with Canada.

Reversing the Appropriations Committee, the House has approved funds for the controversial **Dixon-Yates plant** linking to the TVA system. The President's request for $21,000,000 for an **atomic powered merchant ship** as a part of the "Atom for Peace" program was turned down by the Joint Committee on Atomic Energy.

Advance planning grants of from $2,500,000 to $3,500,000 (the President requested $8,500,000) and capital grants for slum clearance and **urban renewal** of from $50 to $60 million are included. The exact amounts will be settled in conference on this Appropriation Act for the fiscal year ending June 1956, which has been passed both by the Senate and the House.

The Senate has passed S. 2126, **the Housing Act of 1955,** authorizing, among other items, 135,000 public housing units—a figure far greater than that requested by the Administration. Also included in this bill are authorizations for greatly increased amounts for Advance Planning of Public Works and for Urban Renewal work in the Housing Agency.

The Eisenhower $3\frac{1}{2}$ billion **Foreign Aid** bill is making unexpectedly good progress. It has already passed the Senate. The Foreign Operations Administration moves over to the State Department on July 1 and will henceforth be known as the **International Cooperation Administration.** Ohio lawyer John B. Hollister, now serving with the Hoover Commission, will head the new agency.

Both the House and Senate have passed bills **to increase the pay of federal classified service workers:** The former by 7.5 percent; the latter by 10 per cent. Presidential approval of a compromise conference bill for a 7.5 percent boost is expected. The increases would be retroactive to March 1.

House and Senate have both approved extension of the **Renegotiation Act**. The Senate version includes an exemption for most construction contracts let by competitive bidding. Business groups contended the Act was no longer necessary because procurement is not now on an emergency basis. The Renegotiation Board urged renewal because of heavy defense spending. With last year's raising of the exemption limit, all but the largest professional engineering firms are exempt.

The fate of the President's Grand Plan for **highways** is uncertain. The Senate passed the opposition bill, though amended to resemble the administration bill in respect to the percentage of federal contribution for roads on the Interstate System. It provides for $18 billion of federal spending over the next five years, more than doubling the present federal-aid program in its first year of operation.

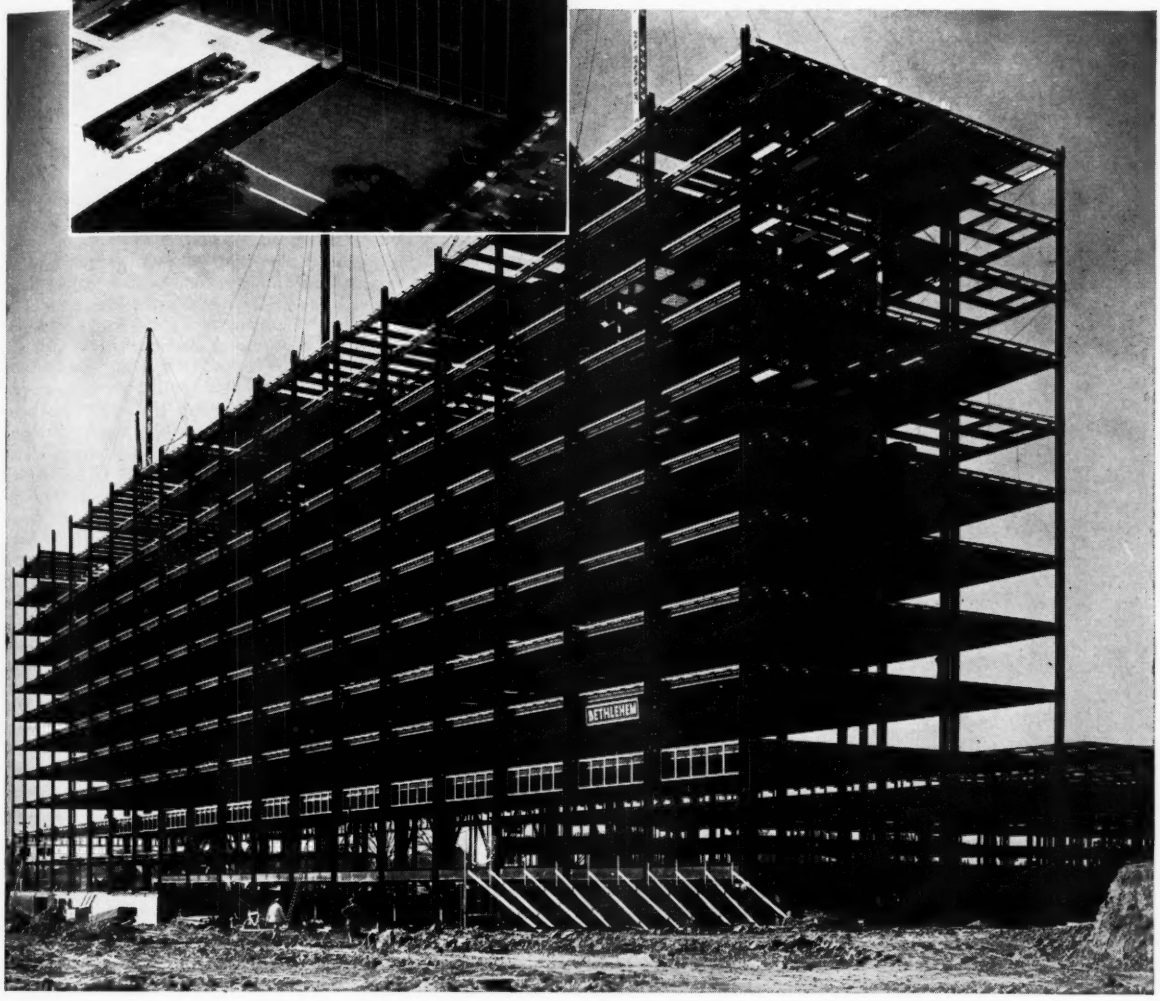
Although the House Committee has not yet acted, informed guesses suggest a likelihood of a 90 percent federal contribution on the Interstate System and a ten-year program based tentatively on the needs as estimated for the Committee by the Bureau of Public Roads and the State Highway Departments.

Both the House and Senate have passed a bill to provide for the expeditious completion of the **Inter-American Highway,** authorizing greatly increased funds for the work. The appropriations Committees are considering the amount to be appropriated.

Washington, D.C.
June 24, 1955

Some of the center's functional and esthetic attributes are indicated by this photograph of a model of the completed project. *Architect:* Skidmore, Owings & Merrill, New York City. *General Contractor:* Bryant & Detwiler Co., Detroit.

Photo of model by Ezra Stoller.



Ford Center Taking Shape in Michigan

This impressive steel skeleton, carrying the familiar "Bethlehem" sign, is the now-complete framework for Ford Motor Company's Central Staff Office Building—widely heralded as "the perfect decentralized work center." The completed structure will provide exceptionally pleasant working conditions for 3,000 Ford administrative employees.

Conveniently located in suburban Dearborn near the intersection of two arterial highways, the center will be surrounded by a park-like 20-acre plot. Dining rooms will be provided in a two-story employee services building.

The twelve-story tower has many interesting architectural features, including column-free floor space — as the outer columns are beyond the line of the porcelain-enamel curtain wall, while inside columns are within the service core. The office space is modular, based on 4-ft-8-in.-square units. Moving stairs will serve seven floors.

Bethlehem fabricated and erected a total of 9700 tons of steel for the office tower building and the adjoining employee services building.

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NEWS BRIEFS . . .

Diverse Technical Program Marks EIC Annual Meeting

The Canadian power situation, the Niagara Falls remedial project, structural steel failure, and nuclear power—these were a few of the subjects spotlighted at the recent sixty-ninth annual meeting of the Engineering Institute of Canada in Toronto.

R. E. Heartz

"Of the more than 7,000,000 hp of hydroelectric power installed in Canada since the end of World War II, only one major turbine was foreign built, and over 60 percent of the horsepower was completely designed in Canada. Moreover, since the war more than 1,500,000 hp has been designed and built in Canada for operation in foreign countries." This statement was made by R. E. Sproule, manager of the Hydraulic Division of the Dominion Engineering Works, in a leading address. Mr. Sproule noted that the 131 turbine units for 47 installations during this period—all manufactured in Canada—showed many spectacular and some record-breaking achievements.

An important feature that has received little publicity, he pointed out, is the large number of big turbines reliably turning out power at high-load factors. For example, the thirteen Beauharnois turbines (allowing for generator efficiency) developed $3^1/_2$ billion kwhr or 76 percent of the turbine rating operating at full time, while the five turbines at Chute Savane developed 81 percent of full load.

Progress was reported on all phases of construction of the Sir Adam Beck Niagara Generating Station No. 2 by Richard Hearn, M. ASCE, chairman of the Ontario Hydro-Electric Power Commission. Ten units are now operating, and the remaining two will be brought into service this year. The pumped storage scheme is scheduled for initial operation late this year, with completion in 1957, he said.

The second stage of the remedial works for preserving and enhancing the scenic beauty of Niagara Falls, and for better utilizing the power resources of the river, is now under way, Otto Holden, M. ASCE, chief engineer of the Ontario Hydro-Electric Power Commission, told the group. Plans call for a control structure immediately below the submerged weir (with thirteen 100-ft sluices between piers controlled with movable gates), removal of rock from the cascades upstream from the Canadian flank, and a crest fill. They also call for a fill to be placed along the crest at the Goat Island flank to divert flow over the flank. Work on the Goat Island flank is now completed, and work on the Canadian flank will start shortly. Work is also proceeding, in stages, on the control structure building (two sluices at a time) so that the river channel will not be obstructed for more than a few hundred feet at once.

The many unique methods employed for making the surveys were described by Dr. Holden. These include echo soundings taken by hydro engineers from a sounding craft allowed to drift downstream from an anchored tug in the rapids immediately above the Falls. Soundings were taken elsewhere with weights suspended from a helicopter hovering at 2,000 ft, the positions of the soundings being located by four instruments on the shore. In some cases dirigible-shaped balloons, made of nylon-covered rubber bladders inflated with helium, were used. From these balloons, called "Kytoons," sounding leads were suspended by nylon cord with the lower 30 ft of the lines (in the water) made of music wire.

Failure of steel at low temperatures in structures is causing a lot of anxiety in engineering circles, according to J. P. J. Dubuc. Dr. Dubuc stated that at the Ecole Polytechnique of Montreal a machine has been constructed capable of repeatedly applying the high loads necessary for performing fatigue-flexure tests on full-sized beams. In addition, the machine is equipped for carrying out tests at sub-zero temperatures. Dr. Dubuc reported that welded beams were found to resist fatigue better than rolled beams at normal temperatures, while at sub-zero temperatures rolled beams showed better resistance than welded beams. Riveted beams at both normal and sub-zero temperatures showed the lowest resistance of all types tested recently.

In the opinion of W. B. Lewis, of Atomic Energy of Canada, Ltd., the large nuclear power plant has not yet arrived at the stage where accurate cost estimates are

Army Builds Arctic Runway in Record Time

Army Engineers recently completed a 5,000-ft snow-compacted airfield in the snow fields near Talkeetna, Alaska (north of Anchorage) in a record-breaking 72 hours. The snow runway was the first built under simulated combat conditions, the engineers parachuting from 1,000 ft in a project that was part of the Army's "Operation Snowbird." Shown here is the pulvi-mixer, called the key unit in successful construction of snow-compacted runways. The pulvi-mixer has tiller-like prongs that tear up several inches of the surface snow and throw it into the flames of eight giant blow torches. The snow is partially melted and returned to the ground to be smoothed by a rear-drag blade. Compaction equipment follows the pulvi-mixer to compress the snow to the proper density as it refreezes.

available. However, he said, there is now reasonable assurance of low fuel costs for thermal reactors, and predicted that reactor costs can be brought to a level at which nuclear power generation is economically competitive with power from other sources. "For example, with a coal-fired power station developing 100,000 kw, the cost of power might vary between 5 and 6 mills per kwhr. Compared with this, the cost of power from a certain type of nuclear power plant of similar capacity might fall between 4.6 and 6.4 mills per kwhr," the speaker estimated.

New EIC Officers and Prize Winners

At the annual banquet Richard E. Heartz, M. ASCE, president of the Shawinigan Engineering Co., Ltd., of Montreal, was installed as president, succeeding D. M. Stephens, of Winnipeg. New vice-presidents inducted into office were Robert M. Hardy, A. M. ASCE, of Edmonton, Alberta; M. A. Montgomery, of Kitchener, Ontario; and R. L. Dunsmore, of Montreal.

John B. Stirling, M. ASCE, president of E. G. M. Cape & Co., Ltd., Montreal, and past-president of EIC, was awarded the Sir John Kennedy Medal, established in 1927 "as a recognition of outstanding merit in the profession or of noteworthy contributions to the science of engineering or to the benefit of the Institute." Richard L. Hearn, M. ASCE, chairman of the Hydro-Electric Power Commission of Ontario, and W. G. Swan, consulting engineer of Vancouver, were recipients of the Julian C. Smith Medals for "achievement in the development of Canada." Frederick P. Shearwood, M. ASCE, and honorary member of the EIC, was awarded the Gzowski Medal for "the best paper of the year on a civil engineering subject."

Lebanon Will Build TVA-Type Project

The first phase of a 25-year program for developing the Litani River Valley in Lebanon will get under way soon with award of an engineering contract to a joint venture consisting of the Ralph M. Parsons Engineering Company, of Los Angeles, and the Harza Engineering Company, of Chicago. On the basis of a survey by Point Four experts in cooperation with local enginers, the Lebanese government is prepared to spend $100,000,000 on the TVA-type project which is expected to double the per capita consumption of electric power in the country and irrigate some 50,000 acres.

Parsons & Harza will draw up specifications and supervise the first stage of the project, which will involve construction of a dam and reservoir, two tunnels and power plants, and an irrigation unit. The first phase will cost in the neighborhood of $40,000,000 over a six-year period.

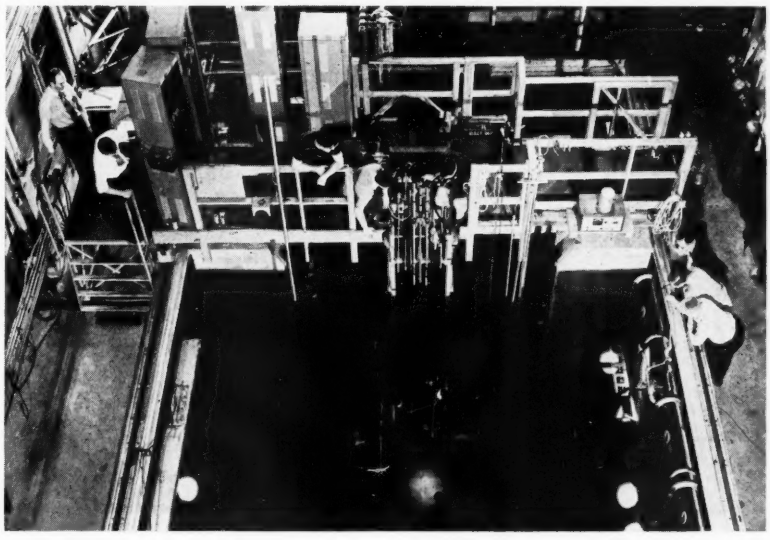
Boston Army Base to Be Rehabilitated

Award of a $7,995,427 low-bid construction contract to the Merritt-Chapman & Scott Corp., of New York, for pier and building rehabilitation at the South Boston Army Base has been announced by the New England Division Engineer for the Corps of Engineers. The project includes the underwater construction of a 50-ft-high concrete retaining wall supported on piles. The top of the wall will provide an additional 27-ft width of unloading area on an existing concrete pier.

Texas Court Approves Turnpike Financing

Financing of the $58,500,000 Dallas-Fort Worth Turnpike by bond sale will be undertaken soon as the result of a favorable decision handed down by the Supreme Court of Texas. The six-lane 30-mile turnpike will save motorists about 26 minutes traveling time between the two cities. Engineers expect the turnpike to be open by July 1, 1957, and to produce gross revenue in the first year of operation in excess of $4,300,000. The Highway Department is building free expressway connections in both cities.

U.S. to Build Atomic Reactor for Geneva Conference



Atomic reactor of the "swimming-pool" type (similar to the reactor at Oak Ridge National Laboratory shown here in bird's-eye view) is being built by the United States for installation in the United Nations "Atoms for Peace" Conference in Geneva, Switzerland, in August. Its name comes from the fact that the reactor is immersed in a 20-ft pool of water which shields effectively against radiation. The fuel will be fuel-grade uranium enriched in isotope 235 to about 20 percent. About 5 kg of U-235 will be required. Cost of the project will be about $350,000. The Oak Ridge Reactor, which is being operated for the Atomic Energy Commission by Union Carbide and Carbon Corp., is shown in operation in the small view. Latter photo was made entirely by the light of atomic radiation from the reactor, the camera lens being left open for one hour.

From the soaking pit, where its temperature has been raised to around 2300 deg. F., the ingot, with dimensions of approximately 90 × 24 in. (in thickness), is rolled into a $2^1/_{16}$-in. plate measuring 133 in. in width by about 60 ft in length (upper view). In this particular rolling job, 56 passes through the mill were used to "squeeze" the ingot to these plate specifications.

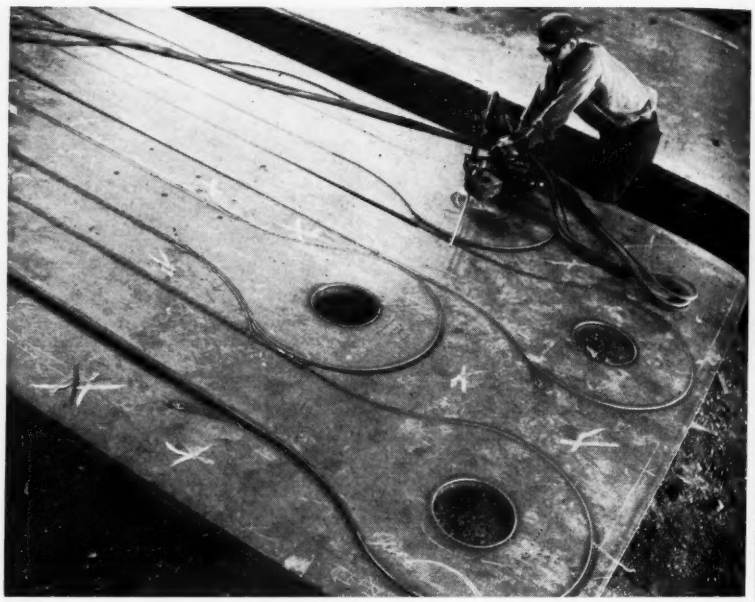
Four of the eye-bars take recognizable shape (photo at right) as they are flame-cut from the extra-wide plate rolled in the preceding step (upper view). Each of the bars being cut here is 55 ft long and weighs 5260 lb. The holes or "eyes," varying in diameter from 12 to 14 in., are for forged steel pins which will hold the bars in position in the bridge structure.

New Method of Eye-Bar

Fabricators of the steel eye-bars for the Richmond–San Rafael Bridge have developed a method that greatly reduces waste in the cutting of the plates. By nesting four eye-bars on an extra wide plate, the By-Products Steel Co., Division of Lukens Steel Co., Coatesville, Pa., was able to cut eye-bars from the plate and save about 900 tons of steel on the contract.

The eye-bars cut by By-Products were carbon manganese steel—heat treated to achieve high strength. On a 5,000,-000-lb testing machine at the Philadelphia Navy Yard, the eye-bars broke at 2,200,-000 to 2,500,000-lb load. All broke in the parallel straight sections, no breaks occurring in the eyes. Every bar submitted for test conformed to the requirements of the ASTM Spec. A6-52aT for open-hearth carbon steel. The specifications for the steel are:

Analysis: carbon, 0.32 to 0.38; manganese, 0.60 to 0.90; phosphorus, 0.04 maximum; sulphur, 0.05 maximum; silicon, 0.15 to 0.30.



Chicago Utilities Plan Private Atomic Plant

A full-scale nuclear power plant financed entirely by private funds will be built in the Chicago area under the auspices of seven private utilities that have organized into a non-profit research corporation to be called Nuclear Power Group, Inc. If the project is approved by the Atomic Energy Commission, it will be the second privately financed nuclear power plant—the Consolidated Edison Company of New York has received AEC approval to build a plant along the Hudson near Peekskill, N.Y. (March issue, page 82). The Chicago plant will be situated on a 750-acre site near the confluence of the Kankakee and Des Plaines rivers in Grundy County.

General Electric will be the prime contractor for the $45,000,000 project, with the Bechtel Corp., of San Franciso, engineer constructor. The plant will have the boiling water type of reactor, which eliminates the need of a heat exchanger in the production of steam, and will have a net electrical capacity of 180,000 kw. It is scheduled for completion in about five years.

The plant will be owned and operated by Commonwealth Edison, which will pay $30,000,000 toward the contract price. Over a five-year period the members of the Nuclear Power Group will supply the remaining $15,000,000 of the contract price in return for valuable technical information to be gained.

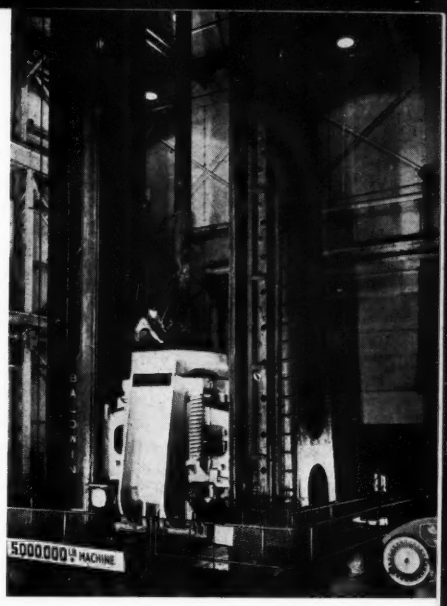
Alaska Builds for Defense

Contracts totaling more than $11,000,-000 in defense construction for the U.S. Army and Air Force were awarded by the Alaska District of the Corps of Engineers in May. The big building program will be pushed at full speed this summer at various sites—Ladd, Eielson, and Elmendorf Air Force Bases, the Air Force Station at Tatalina, the Army Port of Whittier, and the Army's Arctic Center at Big Delta.

The largest contract—for $6,170,357—was awarded for work at Elmendorf and Ladd Air Force Bases to a joint-venture group consisting of Islands Construction, Inc., Anderson Construction Co., Inc., and Montin-Benson Corp., of Seattle.

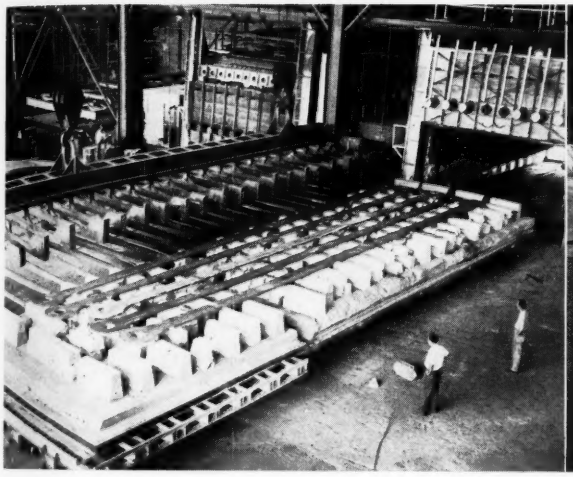
Cutting Saves Steel

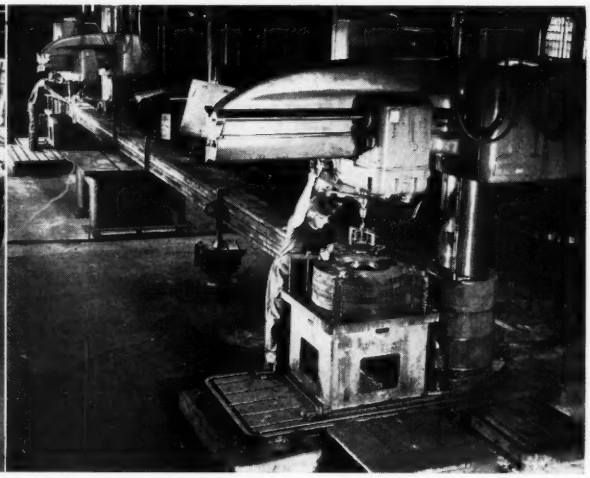
Test criteria (as rolled): ultimate tensile, 70,000 psi; yield, 40,000 psi. After heat treatment (full size): ultimate tensile, 80,000 psi, minimum; yield, 50,000 psi, minimum; elongation in 18 ft, 8 percent minimum; reduction of area, 35 percent minimum.



At upper right is shown a typical tensile test—on a mammoth scale. One bar from each heat of steel used in the project is sent to the Philadelphia Navy Yard where it is pulled to destruction in the Navy's giant 5,000,000-lb tensile-testing machine. The cables arranged along the bar's length are for the purpose of holding the pieces in place after the bar breaks. Specifications in this test are extremely rigid—each bar must show a yield point of at least 50,000 psi and an ultimate strength of 80,000 psi minimum.

After flame-cutting from rolled plate, the bars are heat treated (lower left photo). Here, five of them are shown leaving the huge Lukens heat-treating furnace where they have been heated to a temperature of about 1600 deg F. and held for $2^1/_2$ hours. Next step in fabrication is the machining of the "eyes" of the bars—their most critical feature (lower right view). The rigid specifications and close tolerances to which the bars must be fabricated required that the holes be bored while the bars were stacked in sets of six or eight. The boring mills shown here also had to be so precisely aligned that the distance apart of the finished holes of the bars in each set would be within 0.002 in. of the specified measurement.





Private Firms to Help Los Angeles Sewer Program

The Los Angeles Board of Public Works has been authorized to hire private firms for engineering work involved in $40,000,000 worth of sewer construction—part of a program to be completed under a $60,000,000 bond issue voted last April. According to Cushing Phillips, president of the Board of Public Works, the City Engineer's staff does not have sufficient personnel to handle the work within the time limit set by the program.

Private firms will design the work for expansion of the Hyperion treatment plant, a five-mile ocean outfall, and a main outfall trunk line. The city engineering staff will design relief and interceptor sewers costing $20,000,000. The private firms are Holmes & Narver, Inc., Daniel Mann, Johnson & Mendenhall; and Koebig & Koebig. The consulting engineers on the work are Bowlus-Pomeroy Associates and the office of the late Clyde C. Kennedy.

New Headquarters for Pennsylvania Turnpike

Construction of a new $2,000,000 headquarters building near Harrisburg has been authorized by the Pennsylvania Turnpike Commission. The four-story reinforced concrete and stone building with two two-story wings will be erected on a 17-acre site near the Harrisburg East Interchange. It will feature flexible interior partitions of the movable type, standardized on a constant dimension, which will permit changing the interior of the building as required without costly changes in the structure itself.

Commission Chairman Thomas J. Evans notes that, with the turnpike already more than double its original length, the Commission "needs a lot more room for administration." He recalled that in 1941, the first full year of operation, 1,115,256 vehicles used the highway and brought in $854,405.16 in revenue. In 1954 almost 13,000,000 vehicles used the facility, and gross revenues exceeded $23,000,000.

First Precast Circular Shells Erected in United States

GEORGE J. HARTMAN, A.M. ASCE, Vacuum Concrete, Inc., Philadelphia, Pa.

A new type of curved thin-shell concrete construction called the Ortega-Billner Precast Roof has just been used for the first time in the United States. Half shells were precast in stacks on the ground, vacuum lifted into position, and connected by poured-in-place joints. Formwork was necessary only for the first element cast, and thus the usually high cost for curved forming was kept to a minimum. The resulting roof is a light, economical and fireproof structure.

Since the curved thin-shell technique makes better utilization of steel and concrete than does flat-slab construction, the Ortega-Billner roof can be adapted for various widths and spans. Wide column spacing giving greater unobstructed area is possible. Precasting means that the elements can be stacked and stored and easily installed as needed. The fireproof roof is economical for housing projects, factories, and warehouses due to the maximum of clear space available with the minimum of formwork necessary.

Initial use of this precast concrete roof was for enclosing a swimming pool at St. Joseph's House for Boys in Philadelphia. The overall area is about 100 by 38-ft with column spacing 50 by 38 ft. The approximate dimensions of the barrel roof shells, which are supported at the ends on trusses, are span length 50 ft, chord width 38 ft, rise 6 ft, radius 30 ft, and average thickness $2^1/_2$ in.

The shells were precast in halves so that each element handled was about 50 by 20 ft by $2^1/_2$ in., and weighed close to 15 tons. The concrete used was designed for 5,000-psi compressive strength. The reinforcement for each element was a double layer of 3 × 6 in.—#2/ #2 mesh over the entire surface and 18 rods varying from $^3/_4$ to $^1/_2$ in. dia following the lines of principal stress.

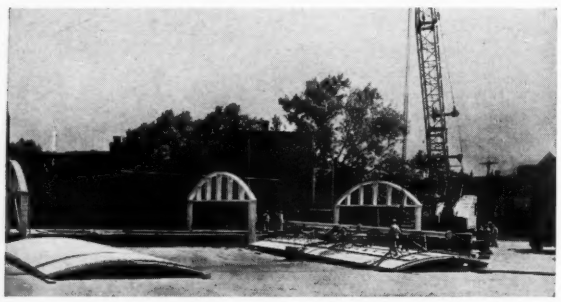
These concrete sections were cast on top of one another by keeping the radius of curvature constant and varying the thickness radially from $2^1/_4$ in. at the crown to $2^3/_4$ in. at the edge. The paper used between layers acted as a bond breaker while also affording a smooth undersurface.

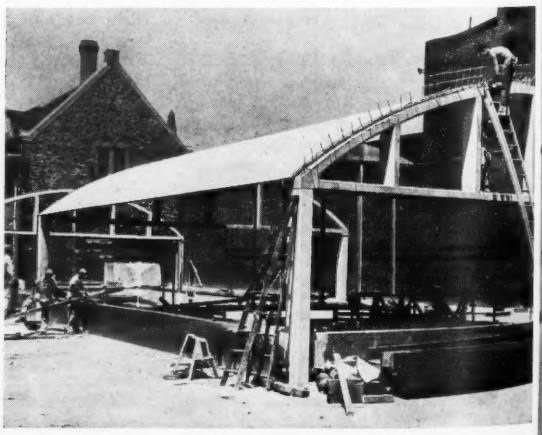
Precast Vierendeel trusses were lifted into position and secured by doweled bolts extending from the concrete columns. The curved roof elements were stripped from the stack and raised onto the trusses by a special Vacuum Lifter invented by Karl P. Billner, president of Vacuum Concrete, Inc. The device consists of a 10-in.-dia pipe 50 ft long connected by hose to a vacuum pump and to two lifting pads each 50 ft long by $1^1/_2$ ft wide. The pipe serves both as a vacuum chamber and as a structural member. A distributed force is applied through the system of pulleys and $^1/_4$-in.-dia-wire rope connecting the pipe to the pads. The latter are plywood mats with perimeter sponge rubber sealing in the vacuum. They attach to the shell to be lifted by atmospheric pressure. By adjustment of the pulley wire lengths, the precast element is lifted at the exact angle and fits correctly on the supports initially.

In the 8-in. poured-in-place longitudinal and transverse joints, the reinforcement extending from each half shell overlapped 6 in. In the transverse joint a tie was made with the dowel bars protruding from the truss. Temporary supports were used until the longitudinal joints obtained sufficient strength.

The cost per square foot of area covered by the roof was $2.00.

Joseph R. Farrell, M. ASCE, Philadelphia, was responsible for construction, and the writer was in charge of engineering.





General view of construction site (at left) shows precast concrete trusses in position on the columns. Precast roof elements and curved thin-shell concrete half-sections are stacked and ready for erection. In lower left photo lifter is seen lowering shell onto trusses. Lifter holds the shell at the proper angle for correct positioning on the truss supports. Shell is shown in position on trusses in lower right-hand photo. When the other half-shells are placed, the poured-in-place joints can be made.

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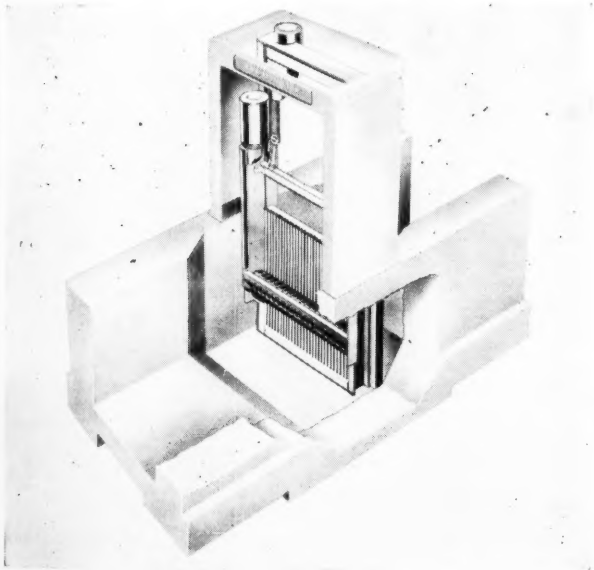
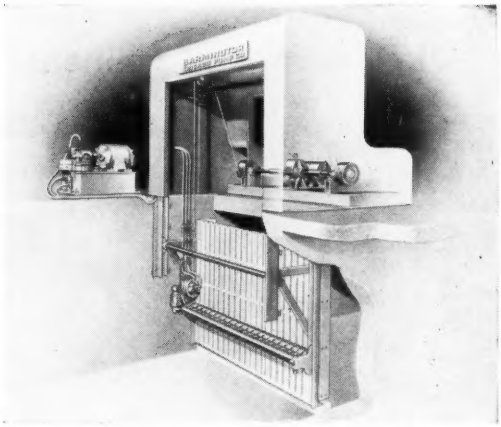
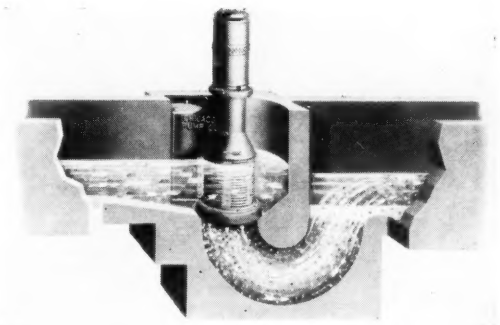




Model "A" Barminutor Screening and Comminuting Machine. Designed for use in rectangular channel sections 4 to 12 feet wide, sized for flows of 10 MGD and upwards.



The Comminutor Screening and Comminuting Machine. Designed for use in hydraulically designed feeder basin, sized for flows from .175 to 25 MGD per machine.

Model "B" Barminutor Screening and Comminuting Machine. Designed for use in rectangular channel sections 1 to 3 feet wide, sized for flows from .09 to 15 MGD.

Model 7B Comminutor Screening and Comminuting Machine. Designed for use in 6" or 8" sewer pipe, sized for flows from .005 to .175 MGD per machine.

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New European Tunneling Record Set

Portal of Glen Almond Tunnel, Glen Lednock, is shown here. On the Glen Lednock heading a European tunneling record of 428 ft in seven days has been achieved. Tunnel is being driven through hard epidiorite.

Driving 428 ft through hard epidiorite rock in seven working days, a tunneling crew of the Mitchell Construction Company has achieved a new British and European tunneling record. This record was established on the Glen Almond Tunnel in the St. Fillan's section of the North of Scotland Hydro-Electric Board's Breadalbane Project. The Mitchell Company, contractors for the tunneling, aqueduct, and ancillary work on the project, began operation in May 1954. Since the start of tunneling in August, nearly 9,000 ft have been driven on six different headings.

With use of six Atlas RH656-4W lightweight drills in the 10-ft-wide GlenAlmond tunnel, 18,300 ft of shot holes were drilled. During the seven days a total of 66 rounds was fired and mucked, giving an average pull of 6.4 ft per round. The best time recorded for one complete cycle of operations, between firing, was 1 hr 55 min.

Normally tunneling crews work a six-day week of two 12-hr shifts, starting at 8 a.m. However, when the possibility of establishing a record became apparent, it was decided to work the entire week. The tunnel crew was in its seventeenth week on the job and had driven 3,300 ft when the record was achieved.

Equipment used on the record-breaking heading included an Eimco 21 rocker shovel, which shifted 21 cu yd per round and worked on a 2-ft-gauge rail track. Diesel locos and 40-cu ft mine cars were used, and switching was achieved with a transportable California switch which lies on top of the rail track and can be brought forward as required.

The six Atlas RH656-4W drills weighing 45 lb with a piston diameter of about $2^1/_2$ in. were mounted on pusher legs. Two standby drills kept in the tunnel were not needed. Sandvik Coromant tungsten carbide-tipped drill steels of $^7/_8$-in. hollow hexagon sections with bit diameters of about $1^1/_2$ in. averaged 1,000 ft. The inserts wore to wafer thinness without breakage of steel. Explosives per round averaged 140 lb of polar ammon gelignite, used with half-second delay detonators. During the record week 9,163 lb of explosives were used.

The Glen Almond tunnel, which will be 17,200 ft long when completed, is being driven from two headings—Glen Lednock (outfall) where the record was achieved, and Glen Almond (intake). Work on the Glen Almond heading began only recently. The break-through is expected early in 1956.

The unlined tunnel, which will carry water from the River Almond to the Glen Lednock Reservoir, is part of a 23-mile tunneling and aqueduct project being carried out by the Mitchell Construction Company.

From the Lednock Reservoir, which is 800 ft. above the St. Fillans generating station, the impounded water will be led through the St. Fillans lined low-pressure tunnel, a penstock shaft (600 ft deep) and tunnel to the generating station at St. Fillans. The tailrace will lead into Loch Earn.

Tunneling operations are also being carried out on the Dalchonzie section of the Breadalbane project where water will be taken from the River Earn via a 16,172-ft-long, $11^1/_2$-ft-dia lined tunnel, and penstock shaft to the Dalchonzie generating station, and discharged back into the River Earn.

The consulting engineers on the project were Sir Murdoch Macdonald & Partners.

[The American driving record for a 10-ft, lined tunnel is 2,442 ft in 31 days with a best 24-hour, three-shift advance of 104 ft. This was set on tunnel No. 1 of the Owens River Gorge Power Project.]

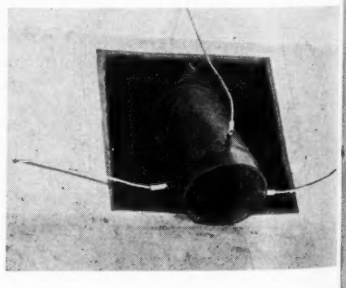
New Culvert Design Cuts Drainage Costs

A new design for highway culverts on steep slopes, which cuts costs and increases the efficiency of water drainage, has been developed by Oregon State College civil engineers. Working with 4-in. clear plastic scale models, engineers found that a hood projection at the top of the culvert will increase the flow of water by more than 50 percent in some cases. Increasing the water flow means smaller and less costly culverts can be used with similar results.

The projection at the top of the culvert "forces" the culvert to flow full when it is submerged by rising headwater, according to Leslie A. Clayton, A. M. ASCE, associate professor of civil engineering. Without it, an air space develops along the inside top preventing full flow of water through the culvert. The stream lines near the bottom of the culvert remain straight, but the water entering the top portion of the culvert with a velocity component perpendicular to the axis of the culvert will not cling to the top of the barrel. The resulting contraction of the stream leaves an air space at the top of the culvert near the entrance.

An important advantage of the design is that the upper projection can be added to culverts already in use. The 2-ft projection can be made from half a pipe or from a beveled piece of metal that is narrow at the bottom and widens out across the top.

Started in 1952 as a student project, the study was later expanded into a full-scale project of the Engineering Experiment Station in cooperation with the Oregon Highway Department. Malcolm H. Karr, a 1953 graduate who is now an engineer for the Eugene (Oreg.) Water Board, started the project. Students helping him were Russell Avery, now airport manager at Klamath Falls, and Virgil R. Morton and Ray V. Walter, all now members of the State Highway Department. All are Junior Members.



The research findings are outlined in a new Engineering Experiment Station bulletin prepared by Mr. Carr and Professor Clayton.

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May Construction Brings Five-Month Total to New High

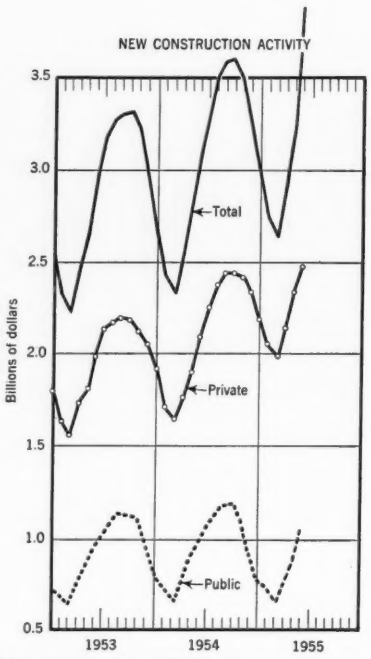
The value of new construction put in place expanded seasonally in May to $3.5 billion, setting a new high for the month and bringing construction for the first five months of the year to a record total of nearly $15.3 billion, according to preliminary estimates prepared jointly by the Departments of Commerce and Labor. After allowance for seasonal changes construction expenditures during May rose to an all-time peak annual rate of $42.1 billion. This compares with an annual rate of $41.1 billion during January 1955 and actual outlays of $37.6 billion in 1954.

Increased activity in nearly all types of private work contributed to the 1955 record rate. Private expenditures totaled $11.1 billion during the January-May period, an all-time high for the period and 21 percent more than private construction outlays in the previous record first five months of 1954. Public outlays during this period were the same as in the corresponding five months of 1954 as a sustained expansion in state and local public works offset continued declines in public housing activity and most types of direct federal construction.

Private residential building activity increased about seasonally from April and outlays were at a new peak for the month of May to complete a record five-month period. The $6.0 billion of work put in place represented a one-third increase over January-May 1954.

Other types of private construction which posted new records for work put in place in the first five months of 1955 were commercial, religious and educational buildings. The current level of expenditures for private educational buildings is lower, however, than the peaks reached in August and September of 1954.

During the January-May 1955 period most individual types of public construction continued at an even rate, after allowance for seasonal factors. Both residential and industrial building were lower than in 1954 by 35 and 41 percent, respectively, and conservation and development work was off by 13 percent. These decreases were offset by gains in public educational building (18 percent), military facilities (13 percent), sewer and water projects (11 percent), and highway construction (8 percent). Hospital construction continued relatively unchanged over the year.



May construction activity soars to new high for the month of $3.5 billion, as indicated in Department of Commerce curves.

NUCLEAR NOTES

XII—Statistics of Nuclear Measurements

This installment of "Nuclear Notes" was prepared by Bernd Kahn at the request of the Sanitary Engineering Division's Committee on Sanitary Engineering Aspects of Nuclear Energy. Mr. Kahn is Assistant Sanitary Engineer, Robert A. Taft Sanitary Engineering Center, U.S. Public Health Service, currently assigned to the Oak Ridge (Tenn.) National Laboratory. Conrad P. Straub, of the Oak Ridge National Laboratory, heads the committee, which also includes Earnest F. Gloyna, A. E. Gorman, Prof. Warren J. Kaufman, Alexander Rihm, Jr., and James G. Terrill, Jr. Next month's subject will be: Preparation of Samples for Assay.

As indicated in Nuclear Notes IV, radioactive atoms differ from stable atoms in that they have an excess of energy. This excess energy is given off in the form of kinetic energy of particles or rays in one or more bursts, after which the atom becomes stable immediately or passes through several unstable stages before becoming stable. This energy emission takes place at random and cannot be predicted for any one atom. The fraction becoming stable at many given times may be computed from statistical considerations if any radioactive atoms are present.

It has been found that the radioactive decay law which defines the rate of disintegration of the atoms present resembles the rate law for monomolecular reactions—that is, for a large number of atoms the rate at which radioactive atoms decay (dN/dt) is proportional to the number of radioactive atoms present. Or, the probability of a radioactive atom decaying in a given interval depends on the length of that time interval. As indicated in Nuclear Notes V, the decay rate and the number of radioactive atoms present (N) may be equated, $dN/dt = -\lambda N$, where λ, the proportionality constant is known as the decay constant. It is constant for any given radioisotope and is a measure of how readily the active atom can transform itself into another atom. It can be measured because $0.693/\lambda$ is the time in which the count rate of the sample has decreased to one-half its initial value. This may be shown by solving the above differential equation to obtain $N = N_0e^{-\lambda t}$ (N_0 being the number of atoms initially present) and substituting $N_0/N = 2$. The count rate is assumed proportional to the disintegration rate, and we know that the disintegration rate is proportional to the number of atoms present as indicated in the first equation.

In a similar manner, the decay rate for radioactive atoms which are created at a constant rate (R), as when radioactive atoms result from the bombardment of inactive atoms or when a radioactive daughter grows during radioactive decay of the parent, may be related to the number of atoms present by $dN/dt = R - \lambda N$ or $N\lambda = R(1 - e^{-\lambda t})$. For a further discussion of this the reader is referred to Chapter V of Friedlander and Kennedy (see reading references).

These equations are true only if a large number of transformations occur—that is, if one repeatedly counts a sample, even a sample whose decay is apparently constant over many years (long half-life), one does not expect to obtain identical values, but rather values that cluster about an average and become closer to the average as the number of counts increases. If the counting rate is small compared to the half-life of a radioisotope, the standard deviation (s_1) is $S_1 = \sqrt{c}/t$, where t is the time interval during which the count (c) was obtained. If the count rate is determined a large number of times, the spread of values will be in the form of a Poisson distribution, with many count rates having the same value and progressively fewer deviating from this value (the number having higher values being somewhat greater than those having lower values). A Gaussian distribution is approached with the values distributed symmetrically about a most probable value if the number of counts collected is large, but small in comparison to the total counts emitted in the life-time of the radioisotope. In this case 68 percent of the count rates obtained will fall within one standard deviation of the average or mean count rate. Hence, in order to obtain high precision in counting, one

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accumulates as many counts as practicable. It should be noted that this deviation from the average is not caused by any experimental error but is inherent in the random nature of radioactive decay. To check this deviation, a number of counts (n) may be obtained from which the deviation (s_2) may be calculated by means of the expression

$$s_2 = \sqrt{\frac{\Sigma(c_{av} - c)^2}{(n-1)\Sigma t}}$$

The value of s_2 should equal s_1, if in obtaining the latter Σc and Σt are used, respectively. If the calculated value of s_2 exceeds s_1, experimental errors may be suspected; if s_2 is found to be smaller than s_1 part of the counts may originate from electronic pulses in the instrument, rather than from ionizing radiation.

When radioactive materials are counted, as has been pointed out in an earlier column, two counts must be taken, a background count and a combined sample and background count. To obtain the sample count, the difference between the two values is obtained. The standard deviation of this difference is the square root of the sum of the squares of the standard deviations of the background count and the background-plus-sample count. In order to obtain the minimum counting time the two counts are arranged so that the ratio of the two times is proportional to the square root of the ratio of the counts.

The interaction of radiation with manner is, in general, just as random as the decay of radioactive atoms, hence in detecting decaying atoms, another statistical problem arises—the probability of counting the radiation entering the counter. Thus, excluding build-up, if a beam of gamma rays passed through a counter, $I_t = I_0 e^{-\mu x}$, where I_t is the intensity of the emerging beam, I_0 is the intensity of the entering beam, μ is the absorption coefficient, and x the thickness of the counter. The similarity to the radioactive decay law is obvious. Hence, the fraction of beam detected by the counter is $(1 - e^{-\mu x})$.

In all detectors a minimum number of ion pairs must be formed by a particle or ray passing through a counter in order that a countable pulse be registered in the electronic system of the counter. The probability P(p) that p-ion pairs will be formed by radiation ionizing an average number of pairs q in the counter is

$$P(p) = \frac{q^p e^{-q}}{p!}$$

Since every radiation forming the minimum number of ion pairs (p_n), or more, is counted while no radiation forming less than this number is counted, the counting efficiency for a counter is

$$1 - p(p_n - 1) - p(p_n - 2) - \ldots - p(p_n - n), \text{ where } n = p_n.$$

For a G-M counter, one ion pair is sufficient to cause a count, hence the counting efficiency is $1 - p(0)$, which is $1 - e^{-q}$. In most G-M counters q is sufficiently large so that the counting efficiency is 1 for particles; however, if q is small (because of the short path of the radiation few ion pairs form along the path length, or of low density of the gas to be ionized), not every radiation entering the counter is detected. Other reasons for a counting efficiency of less than 1, such as the finite resolving time of counters, were discussed in Nuclear Notes XI.

Suggested Reading

G. Friedlander and J. W. Kennedy, *Introduction to Radiochemistry* (Chapters I, V, and IX). John Wiley and Sons, Inc., New York, 1949.

E. Pollard and W. L. Davidson, Jr., *Applied Nuclear Physics* (Chapter V). John Wiley and Sons, Inc., New York, 1942.

R. E. Lapp and H. L. Andrews, *Nuclear Radiation Physics* (Chapter VI). Prentice-Hall, Inc., New York, 1948.

N. G. Neare's COLUMN

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"Four," called Joe Kerr.

"Seven," added Bardie Taylor.

"Nine!" "Three!" "Eight!"

"Yippy!" yelled Bardie, reaching for a pile of dimes.

"What's yippy?" wondered Professor Nears.

"It's the game-of-the-month."

"Gambling? Our Engineer's Club rules..."

"Heck, we aren't playing for keeps—just researching. You see, in Yippy each player in turn antes a dime and rolls the one bone, calling the accumulated sum, just as in cribbage except that the game is 11 instead of 31. Instead of a 'go,' the count goes backward. We rolled in order 4, 3, 2, 6, 5 and 3, counting up to 9 on the third call, back to 3 on the fourth and up to 11 on the sixth. But you never call '11'; you just yell 'Yippy' and grab the loot."

"Still sounds like gambling."

"No, it's real research. Bardie's pot was only 60 cents, but sometimes we run over $2. We're finding the average pot, which can't be computed."

"I'll bet a dime Cal Klater can, and I'm not gambling. Suppose you and Bardie play 1,000 games to check him, with matches instead of dimes, and we'll have a showdown in September. But here's Guest Professor Jenney champing at the bit for his show on Marilyn."

"Right, Noah, and since I can guess Joe's more interested in Yippy than Marilyn, I'm not going to fool around with him. Cal, how many fence posts one marilymeter apart surrounded Diamond Field if ack-ack from guns at the four corners found the space ship at ranges of 30, 31, 32 and 33 marilymeters?"

"I counted 60, Professor Jenney. I set the problem up in cartesian space, with the diamond centered in the XY-plane and its diagonals on the X- and Y-axes with lengths of $2r$ and $2s$ respectively. Then with the space ship in the first octant at (x, y, z), the 4 distances give the equations:

$$(x - r)^2 + y^2 + z^2 = 900 \quad \ldots (1)$$

$$x^2 + (y - s)^2 + z^2 = 961 \quad \ldots (2)$$

$$(x + r)^2 + y^2 + z^2 = 1{,}024 \quad \ldots (3)$$

$$x^2 + (y + s)^2 + z^2 = 1{,}089 \quad \ldots (4)$$

Then, subtracting (1) + (3) from (2) + (4), I found

$$s^2 - r^2 = 63 \quad \ldots \ldots (5)$$

which has the three solutions 8, 1; 12,9; and 32,31. But only when $r = 9$ and $s = 12$ will the side of the diamond be an integer, 15, so that the fence posts come out even. With 16 fence posts on each side, there were 60 in all."

"You mean *64* in all," jeered Joe Kerr.

"Think it over when you've had your 1000 Yippies."

"Cal's 60 is right," decided the Guest Professor. "It should be added that the order of the ack-ack ranges wasn't specified. The other two possibilities are 30, 32, 31, 33 and 30, 31, 33, 32, for which $s^2 - r^2$ will be 126 and -2 respectively, but neither leads to a diamond with integral sides."

"Thanks," concluded Professor Neare. "Dont forget the game of the month, for which I'll give you one hint: there are 5 ways of computing the average pot and only 4 ways are difficult."

[*Cal Klater was Thatchrite (Guy C. Thatcher) and the Guest Professor was Richard Jenney.*]

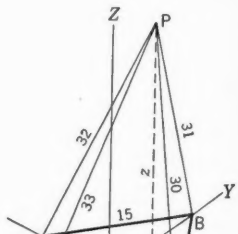
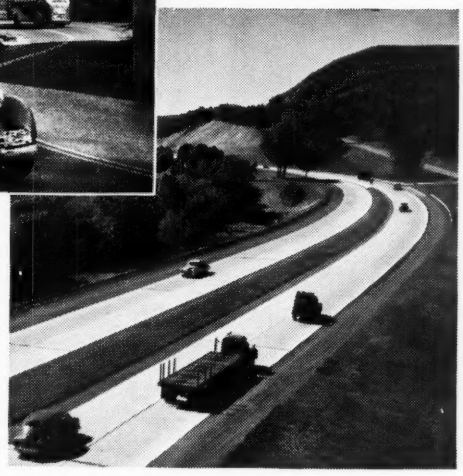
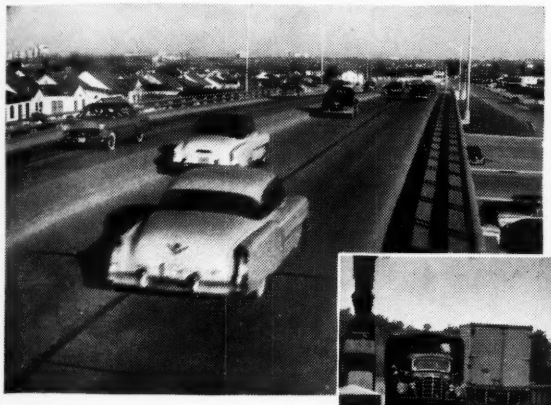


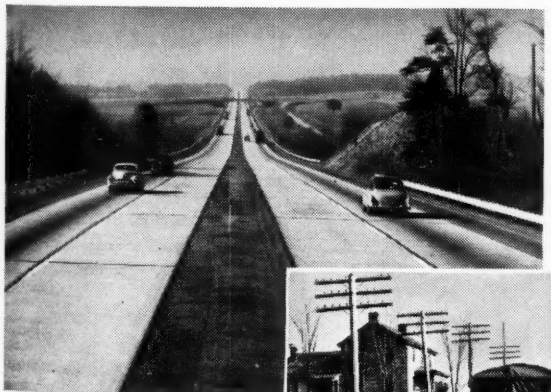
Fig. 1. Diamond Field ABCD, defended against Space-ship P, depended on 4 guns and 60 fence posts.



Sharp, blind turns and "S" curves are killers. Engineers eliminate such hazards by designing modern roads like the one at the right with broad, sweeping curves that the driver can negotiate safely without slowing down.



Narrow bridges (right) are dangerous. Today engineers design bridges wide enough for expected traffic (above).



Inadequate sight distances such as at the right invite disaster. Modern highways need the built-in safety of long sight distances. Engineers eliminated blind spots in designing the highway above.

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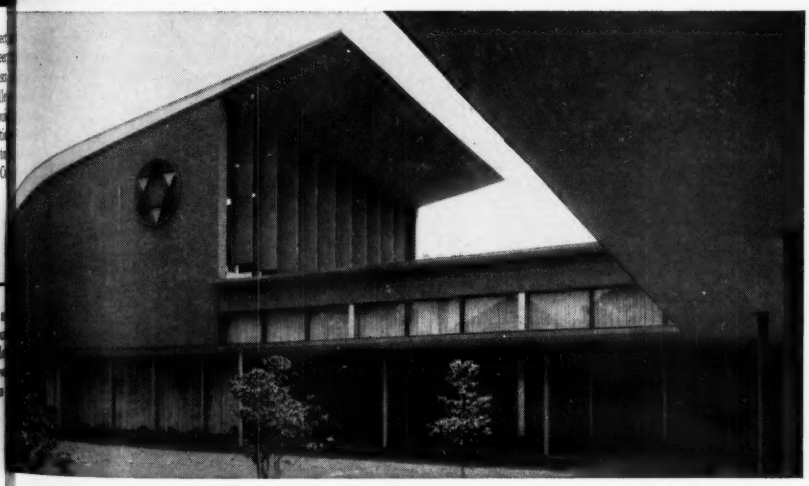

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DECEASED

William Eugene Byrne (A.M. '24), age 63, consulting engineer of Columbus, Tex., died on May 1. Previously Mr. Byrne was civil engineering associate with the Los Angeles Bureau of Engineering. He had also been county engineer for Comanche and Caddo counties in Oklahoma, and for four years was valuation engineer with the James I. Tucker Co. in Oklahoma City. Mr. Byrne graduated from the University of Oklahoma in 1916.

Harry Thomas Cory (M '07), age 84, who had a civil engineering practice in Los Angeles, Calif., from 1928 until he retired, died on March 22. He had been consultant to the Los Angeles Agency of the Reconstruction Finance Corporation, the Soil Conservation Service at Albuquerque, N. Mex., and Washington D.C., and during the war was with Douglas Aircraft Corp. Earlier he had been chief engineer and then president of the Palos Verdes Water Co., Los Angeles. Mr. Cory was a director of General Foreign Relief for the American Red Cross in World War I. He was a graduate of Purdue University with master's degrees in civil and mechanical engineering.

Donald Edward Larson (A.M. '37), age 50, died at Eureka, Calif., on June 7. Since 1946 Mr. Larson had been a partner in the firm of George C. Jacobs Co. at Eureka. Earlier he was on the engineering staff of the Chicago Bridge and Iron Co., Chicago, which he joined in 1930. During the war he was general manager of the floating dry dock construction yard for the company at Eureka. Mr. Larson graduated from Oregon State College in 1928, and received his master's degree from the University of Illinois in 1930.

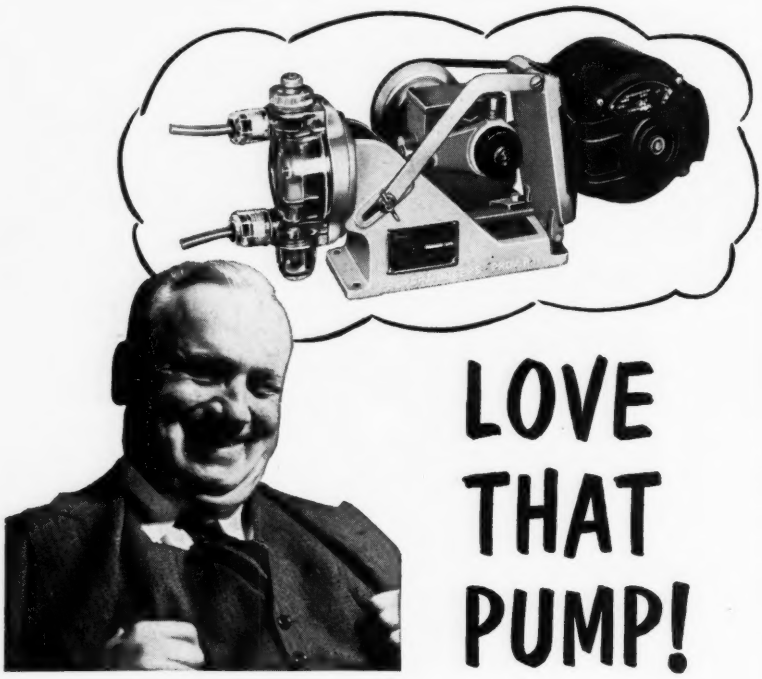
Morris Wooten Loving (A.M. '21), age 63, consulting engineer of Glenview, Ill., died this past December. A graduate of Virginia Polytechnic Institute, class of 1912, Mr. Loving was with the Baltimore Sewage Commission for four years before serving in World War I as a captain in the U.S. Army Engineers. From 1919 until he started his consulting practice he was hydraulic engineer with the Portland Cement Association in Chicago. For many years Mr. Loving was secretary of the American Concrete Pipe Association, and he had also served on various committees of the American Society for Testing Materials.

James Ross Maccoun (J.M. '50), age 26, civil engineer with A. Teichert & Son, Inc., Sacramento, Calif., was killed in an automobile accident on April 28. Mr. Maccoun graduated from the University of California in 1950 and then worked as an engineer for T. V. Tronoff in Berkeley.

Gilbert Francis Mellin (A.M. '24), age 61, since 1943 assistant chief engineer and appraiser for the Reclamation Board, State of California, died in Oroville on April 26. A graduate of the University of California, class of 1916, Mr. Mellin devoted his career to irrigation, drainage, flood protection and land appraisal. For seven years he was engaged in design of flood control structures for the Sacramento and San Joaquin Drainage District. From 1929 to 1932 he worked for the State of California on land classification and determination of water requirements in connection with the Central Valley Project, and from 1936 to 1943 was chief right-of-way agent for the U.S. Bureau of Reclamation on the Central Valley Project.

Vol Hardwicke Montgomery (A.M. '29), age 55, of Abilene, Tex., died at Clearwater, Fla., on March 29 while on vacation. He was an engineer for the

(*Continued on page 98*)



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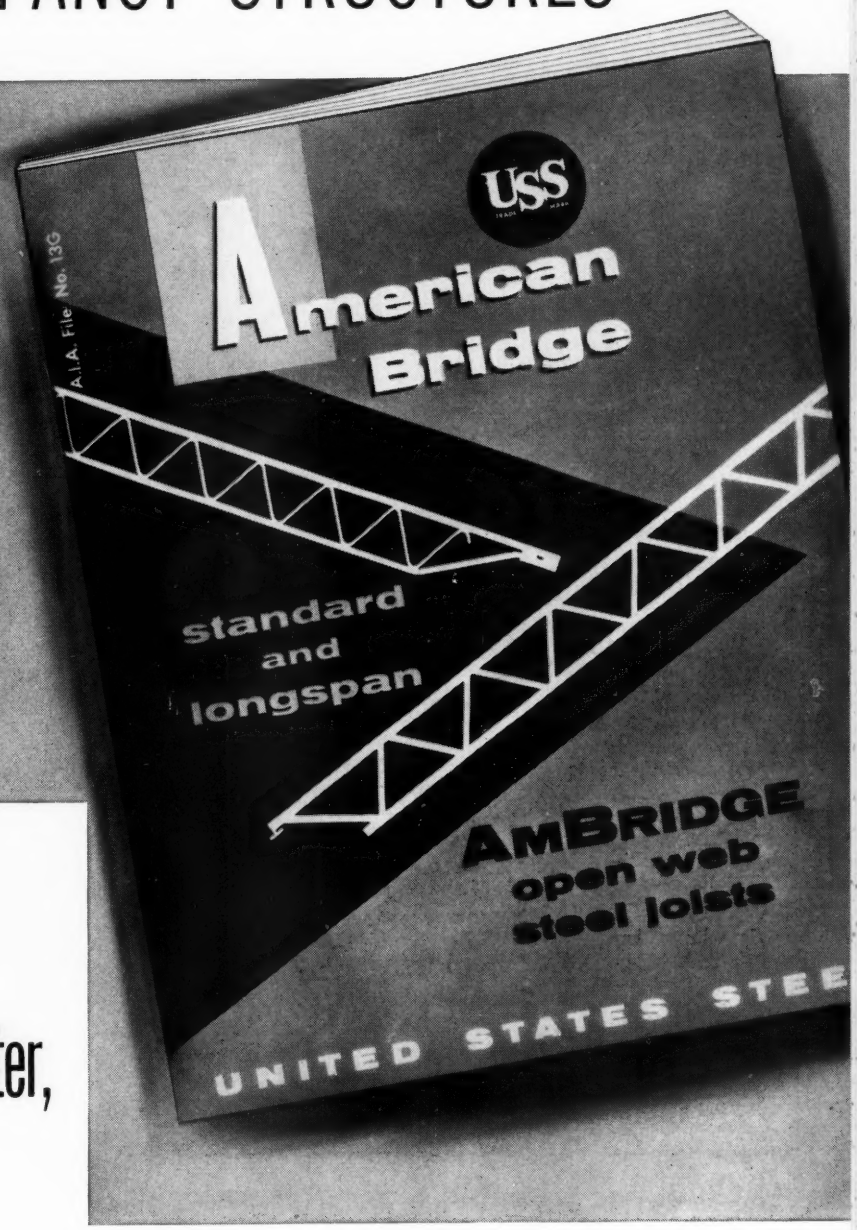

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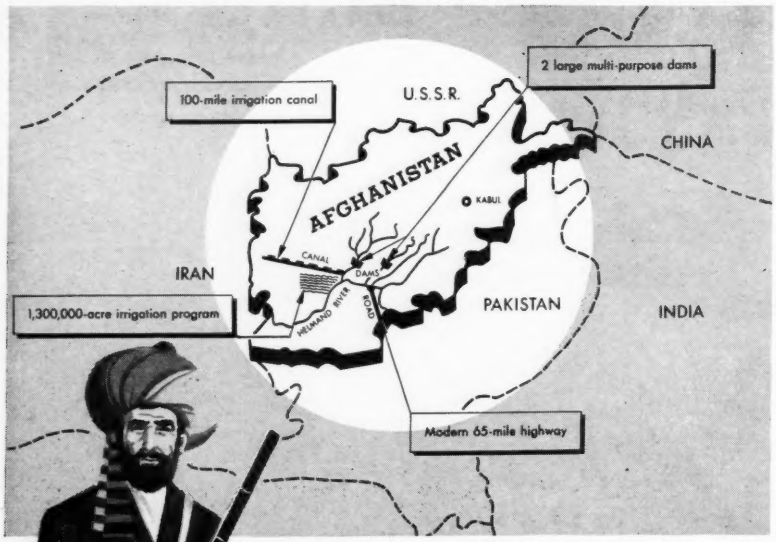

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Deceased

(*Continued from page 96*)

Consolidated Western Steel Corp., of Houston. Mr. Montgomery had been with Winston Brothers at Carlsbad, N. Mex., and structural engineer with Austin Brothers at Dallas, and had had engineering and contracting practices in Abilene and Chillicothe, Tex. He was a graduate of Texas A. & M. College, class of 1924.

William C. Mooney (A.M. '47), age 65, construction engineer and consultant of Albuquerque, N. Mex., died on May 10. After working for various construction companies, Mr. Mooney had his own contracting business in Michigan from 1924 to 1932. He then worked as construction engineer for J. A. Utley, Construction Engineer of Detroit and as construction and industrial engineer for the Giffels & Vallet Co., Smith, Hinchman & Grylls, and the Taylor Gaskin Co., all of Detroit. Mr. Mooney attended the University of Michigan School of Engineering.

William Matthew Stieve (A.M. '18), age 67, who had been senior civil engineer with the New York Department of Public Works, Albany, and associated with the department for the past thirty-one years, died on March 13. A 1909 graduate of Rensselaer Polytechnic Institute, Mr. Stieve began his career in railroad work and in World War I worked for the U.S. Navy Department in Washington, D.C. Prior to joining the Public Works Department he worked for the Hudson River Connecting Railroad and was civil engineer with William Russel Davis at Albany.

Arthur John Turner (M. '20), age 76, retired chief engineer with the Washington Water Power Co., Spokane, died recently. Mr. Turner was superintendent of Hydraulic Construction for the Washington Water Power Co. from 1908 to 1916 and, after a period on various power projects, rejoined the company in 1925 as superintendent of construction. He became chief engineer in 1935. In the interim he worked for the Columbia River Basin Survey Commission at Ellensburg, Skagit River Power for the City of Seattle, and the Reclamation Service. He graduated from Washington State College in 1905.

Jacob J. Weinrib (A.M. '29), age 54, of Hollis, N.Y., died while vacationing in Montgomery, Ala., on May 25. A graduate of Rensselaer Polytechnic Institute, class of 1922, Mr. Weinrib had been engineer for Pan-American Petroleum & Transport Co., New York City, since 1927.

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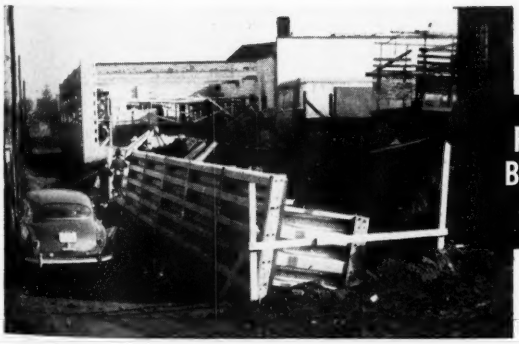

Retain Built-Up Land

When backfilled, this Armco Wall will provide parking area for automobiles in a downtown area. The symmetrical design of the wall presents an attractive appearance.

Write us for complete information about Armco Bin-Type Retaining Walls. Helpful, authoritative data is yours for the asking. Armco Drainage & Metal Products, Inc., 5735 Curtis Street, Middletown, Ohio. Subsidiary of Armco Steel Corporation. In Canada: write Guelph, Ontario. Export: The Armco International Corporation.

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WITH ERRATIC SOIL conditions throughout the project, many problems beset the contractor installing this big steel waterline.

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New in Education

Liberal Arts in Engineering Curricula. The University of Kansas City and Carnegie Institute of Technology have set up five-year programs leading to a B.A. and an engineering or science degree. The cooperative program, effective this September, includes a three-year science major plus liberal arts courses at the U. of K., and two years of science or engineering at Carnegie . . . . . A similar program has been started at Duke University. The program, open to a limited number, calls for three years at a liberal arts college and two at Duke . . . . . Massachusetts Institute of Technology now offers a double major, requiring four or five years, under sponsorship of the Department of Humanities.

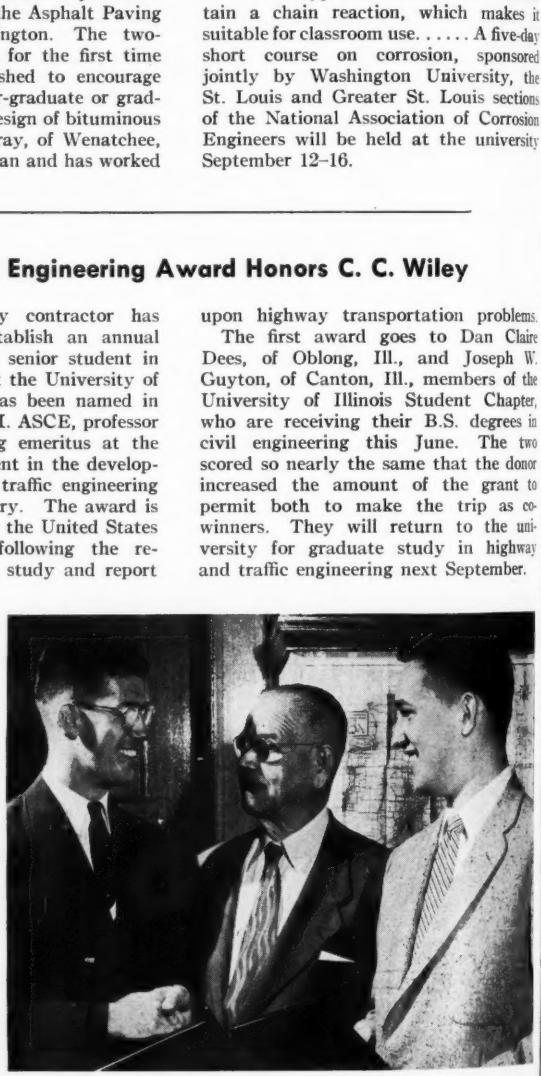
Scholarships and Grants. Thomas G. Gray, a senior in Civil Engineering at Washington State College, has been named first winner of a $500 Scholarship in Civil Engineering given by the Asphalt Paving Association of Washington. The two-semester award, given for the first time this year, was established to encourage the education of under-graduate or graduate engineers in the design of bituminous paving mixes. Mr. Gray, of Wenatchee, Wash., is a Navy veteran and has worked for the State Highway Department and the City of Pullman. . . . . U.S. Steel Foundation, Inc., has extended its 1954 aid-to-education program for 1955, with grants totaling more than $1,000,000 to over 400 colleges and universities. The program provides $500,000 for capital grants, $480,000 for operating grants and $72,000 for graduate fellowships.

New Courses. The American Society for Engineering Education, the Structural and Mechanics Divisions of ASCE and Lehigh University are co-sponsors of a summer course in plastic design in structural steel, September 7–15, at Lehigh. Planned primarily for engineering educators, the course will be followed later by shorter conferences for practicing engineers. Lectures will be given by the staff of Lehigh's Fritz Engineering Laboratory. . . . . The New York University College of Engineering will inaugurate programs in nuclear engineering and engineering science this fall. The college is also discussing with the Atomic Energy Commission plans for constructing a subcritical nuclear reactor for laboratory use. This type of reactor cannot maintain a chain reaction, which makes it suitable for classroom use. . . . . A five-day short course on corrosion, sponsored jointly by Washington University, the St. Louis and Greater St. Louis sections of the National Association of Corrosion Engineers will be held at the university September 12–16.

Highway Engineering Award Honors C. C. Wiley

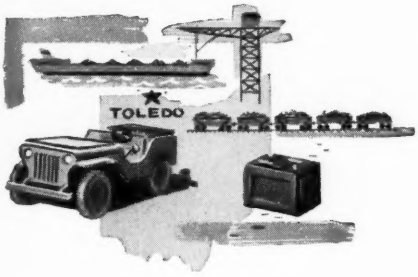
An Illinois highway contractor has provided funds to establish an annual award of $1,200 for a senior student in highway engineering at the University of Illinois. The award has been named in honor of C. C. Wiley, M. ASCE, professor of highway engineering emeritus at the university and prominent in the development of highway and traffic engineering for almost half a century. The award is to be used for travel in the United States during the summer following the recipient's graduation to study and report upon highway transportation problems.

The first award goes to Dan Claire Dees, of Oblong, Ill., and Joseph W. Guyton, of Canton, Ill., members of the University of Illinois Student Chapter, who are receiving their B.S. degrees in civil engineering this June. The two scored so nearly the same that the donor increased the amount of the grant to permit both to make the trip as co-winners. They will return to the university for graduate study in highway and traffic engineering next September.



C. C. Wiley, life member of the Society and one of the organizers and first secretary of the Illinois Section, presents the C. C. Wiley Traveling Award in Highway Engineering for 1955 named in his honor to two University of Illinois seniors —Joseph W. Guyton (left) and Dan Claire Dees.

Toledo Prefers Concrete Pressure Pipe



Toledo engineers prefer concrete pressure pipe for the city's water supply mains. In 1948 an 8,600-foot installation, known as the Bancroft Street Crosstown Main, was completed. Since then 24″, 36″, 48″ and 72″ concrete pressure pipe has been used in major additions to the city's water supply system. Just recently contracts have been signed by Lucas County authorities and work is in progress on additional projects in the Toledo area, involving 16″ and 24″ pipe.

There are a number of reasons for Toledo's increasing use of concrete pressure pipe. Sustained high-carrying capacity and long life are two of the most important. Another is low maintenance cost. The original cost is also low and installation is accomplished quickly and easily.

Talk to Toledo engineers when you plan your next water line. You'll learn why they like concrete pressure pipe—not only for transmission lines, but for city distribution mains as well.

Member companies manufacture concrete pressure pipe in accordance with nationally recognized specifications

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Non-ASCE Meetings

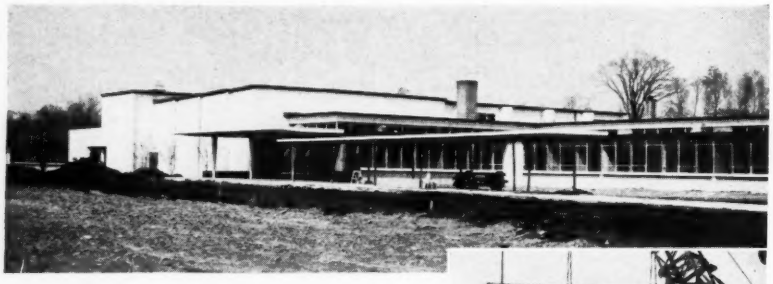
Fédération Internationale de la Précontrainte. Second International Congress at Amsterdam, Netherlands, August 29–September 2. Excursions to view prestressed and other construction. Further information from J. A. H. Hartmann, Secretary, Groningsestraat 15, The Hague, Netherlands.

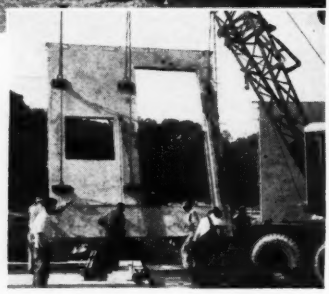
General Motors. General Motors Powerama on South Lake Shore Drive (next to Soldier Field), Chicago, August 31 to September 25. Further information from R. C. Fleming, Director of Public Relations, Allison Division of General Motors Corp., Indianapolis 6, Ind.

Society of American Military Engineers. First annual Western Regional Convention at the Olympic Hotel, Seattle, Wash., August 18–20, registration, August 17. Further details from Prof. F. H. Rhodes, Jr., Convention Chairman, University of Washington, Seattle 5, Wash.

Society of Automotive Engineers. Golden Anniversary West Coast Meeting at the Hotel Multnomah, Portland, Ore., August 15–17. Information from SAE, 29 W. 39th St., New York 18, N.Y.

Stanford Research Institute. Second Western Area Development Conference at the Multnomah Hotel, Portland, Ore., September 8 and 9. Co-sponsors are the American Industrial Development Council and the Pacific Northwest Trade Association. Information from Stanford Research Institute, Pacific Northwest Division, Suite 801–2, Equitable Building, Portland, Ore.





Why They Used Plastiment in Connecticut's "Lowest-Cost-for-Highest-Quality" School

Using tilt-up construction methods in this school at Woodbridge, Connecticut, the contractor steel-trowelled the Plastiment-concrete floor slab, coated it with a parting agent, and cast 120 6-inch-thick Plastiment-concrete wall panels directly on the floor surface.

When the panels were lifted for tilting, the sides next to the floor were as smooth as the floor slab itself. The panels were turned and the bottom side used for the exterior face. No steel-trowelling of the wall panels was needed, since Plastiment-concrete's uniform surface was absolutely free of cracks, pock-marks or blemishes of any kind. Uniform surface was doubly important here because of the delicate pink color of the panels.

While Plastiment contributes uniformity and crack resistance through low water/cement ratio and retarded set, it also gains strength faster than ordinary concrete after the initial retardation stage, enabling the contractor to tilt up the stronger Plastiment-concrete panels sooner than with ordinary concrete, without risk of damage to open door and window sections.

Total savings — one steel-trowelling operation, plus a saving in tilt-up time, in Connecticut's lowest-cost school to date.

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Contractor: The Gellatly Construction Co.

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New Publications

Waste Water Reclamation. Studies of feasible methods of reclaiming and utilizing sewage and industrial waste water as a source of supply, made for the California Water Pollution Control Board, are reported in the Board's Publication No. 9. The survey of California practices indicates that there are about 106 locations where waste waters are used for irrigation, 112 where they are disposed of by recharge of the underground aquifer, and one location where they are used in manufacturing. More than 1,000,000 acre-ft of waste water was found potentially available for reuse in the state. The studies were under the supervision of Albert F. Bush, A.M. ASCE, assistant professor of engineering at the University of California. A limited number of copies of the report are available upon request to the State Water Pollution Control Board, Room 610, 721 Capitol Avenue, Sacramento 14, Calif.

Metropolitan Highways. A study of important links in the arterial highway system of the New York–New Jersey Metropolitan Area—initiated in February 1954 by the Triborough Bridge and Tunnel Authority and the Port of New York Authority—has been described by the two agencies in a publication entitled *Joint Report on Arterial Facilities in the New York-New Jersey Metropolitan Area.* Inquiries should be addressed to the Director of Public Relations, Port of New York Authority, 111 Eighth Avenue, New York.

Hydraulics Research. A paper describing the development of generalized design rules for a new stilling basin for use with the straight drop spillway has been issued by the St. Anthony Falls Hydraulic Laboratory of the University of Minnesota as its Technical Paper No. 15, Series B. Field experience indicates that the new design will adequately protect the downstream channel from scour. The U.S. Department of Agriculture in cooperation with the Minnesota Agricultural Experiment Station and the St. Anthony Falls Hydraulic Laboratory, conducted the study, which is reported by Charles A. Donnelly and Fred W. Blaisdell, M. ASCE, hydraulic engineers for the Department of Agriculture. Copies may be purchased from the Director of the Laboratory, Hennepin Island, Minneapolis 14, Minn., at 75 cents each.

Highway Research. Various aspects of highway research are studied in two recent Highway Research Board bulletins. Bulletin 90, dealing with vertical sand drains, consists of two papers in the field presented at the Board's thirty-third annual meeting. Bulletin 99, entitled *Parking Requirements in Zoning Ordinances,* brings up to date a 1950 study that formed the basis for the Board's previous Bulletin 24. They are for sale by the Highway Research Board, 2101 Constitution Avenue, Washington, D.C., at 60 and 75 cents, respectively.

(*Continued on page 104*)

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New Publications

(*Continued from page 102*)

Highway Materials, Standards. Latest standard and tentative specifications, test methods, and definitions of terms pertaining to mineral aggregates, concrete, and non-bituminous highway materials are included in a new compilation of ASTM Standards, sponsored by Committee C-9 on Concrete and Concrete Aggregates and Committee D-4 on Road and Paving Materials. The 352-page book, including 103 ASTM designations, will be useful to producers and consumers of mineral aggregates, concrete, and highway materials and to engineers and contractors in building and heavy construction. Copies may be obtained from the American Society for Testing Materials, 1916 Race Street, Philadelphia 3, Pa. The price is $3.50.

Engineering Education. Nearly 300 teaching and learning aids in three branches of engineering and in mathematics and mechanics are described in *Educational Aids in Engineering*, a 72-page illustrated catalog published by the American Society for Engineering Education. Future editions will cover other engineering branches and additional service areas. Copies, priced at $1 each, are being sold by the Executive Secretary of the ASEE, 1201 West California, Urbana, Ill. A check must accompany each order.

Engineers in Industry. A well-documented report on all phases of the professional and economic life of engineers employed in all types of industry has been prepared by the Engineers-in-Industry Committee of the NSPE. Chapter headings include the Taft-Hartley Act as it relates to professional employees; the influence of unions; incompatibility of unionism and professionalism; and a program of action. Copies of the 128-page, paper-bound volume are available on request to the NSPE headquarters at 1121 Fifteenth Street, N.W., Washington, D.C. They sell for $3 each.

Painting Steel. Release of the second volume of its *Steel Structures Painting Manual* is announced by the Steel Structures Painting Council, 4400 Fifth Avenue, Pittsburgh 13, Pa. Called "Systems and Specifications," the new publication contains specific recommendations for painting a tremendous variety of steel structures and surfaces in various exposures. Guides and indexes make it easy to specify quickly and correctly complete paint jobs for new or maintenance painting. Copies of the 300-page publication may be ordered from the Council at $6 each, postage paid.

Highway Research. Research on influence lines for continuous beams—conducted under a continuing agreement between the State Roads Commission of Maryland and Johns Hopkins University—is described in the university's recently released Technical Report No. 3. Authors of the present study (Part 1, *Two-Span Continuous Beams, Constant Moment of Inertia*) are Walter C. Boyer, A.M. ASCE, and Joel I. Abrams, J.M. ASCE. Inquiries should be addressed to the Johns Hopkins Press, Johns Hopkins University, Baltimore, Md.

Climate and Industrial Efficiency. For industrialists wishing to take advantage of recent findings of government-sponsored research into the influence of climate and water supply on industrial efficiency, there is a new 165-page report of the Department of Commerce's Office of Technical Services. Examined in detail are the requirements and best probable plant locations for petroleum refining, rubber, iron and steel, transportation equipment, machinery and tools, and power plants. The report, which is identified as PB 111454, sells for $3, and may be obtained from OTS, U. S. Department of Commerce, Washington 25, D.C. Checks should be made payable to the Office of Technical Services.

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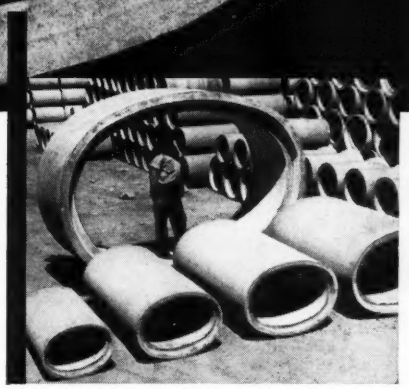

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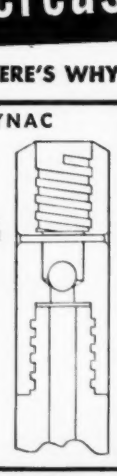

Note the thick shoulder of the LYNAC Head.

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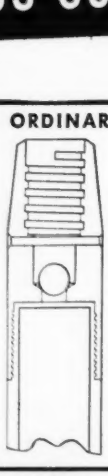
Thin, weak barrel and head are easily damaged.



Compare the thin, easily cracked shoulder of the standard head.

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The theory formulated in vol. I is here applied by the author, Keith Swainger, to various stress conditions of rather generalized nature such as homogeneous or heterogeneous two-stress situations, rubber deformation, and couples applied to massive bodies. Experimental evidence has been examined and incorporated in the treatment. Subsequent volumes are to deal with buckling, thin plates, vibrations, and similar topics. (Macmillan Company, 60 Fifth Avenue, New York 11, N.Y., 1955. 365 pp., $13.50.)

A Professional Look at the Engineer in Industry

The purpose of this study by the National Society of Professional Engineers is to examine the methods by which the interests of engineers working as employees can be defined, recognized, and treated. The legal background—the Wagner and Taft-Hartley acts—is discussed in relation to engineering organization, the causes of dissatisfaction are analyzed, and the issue of professionalism versus unionism is examined. Recommendations for a program of action include the improvement of professional status, improvement in employment conditions, and improvement in economic position. (National Society of Professional Engineers, 1121 15th Street, N.W., Washington 5, D.C., 1955. 124 pp., $3.00—members $1.50.)

ASTM Standards on Mineral Aggregates, Concrete, and Non-Bituminous Highway Materials

This compilation of 103 standards covers crushed stone, crushed slag, gravel, and light weight aggregates; ready-mixed concrete; air entraining admixtures; brick and block pavement material; concrete curing material; expansion joint fillers; and concrete. Test methods discussed include tests for air content of concrete; freezing and thawing; flexural and compressive strength; and the slump test. (American Society for Testing Materials, 1916 Race Street, Philadelphia 3, Pa., 1954. 339 pp., $3.50.)

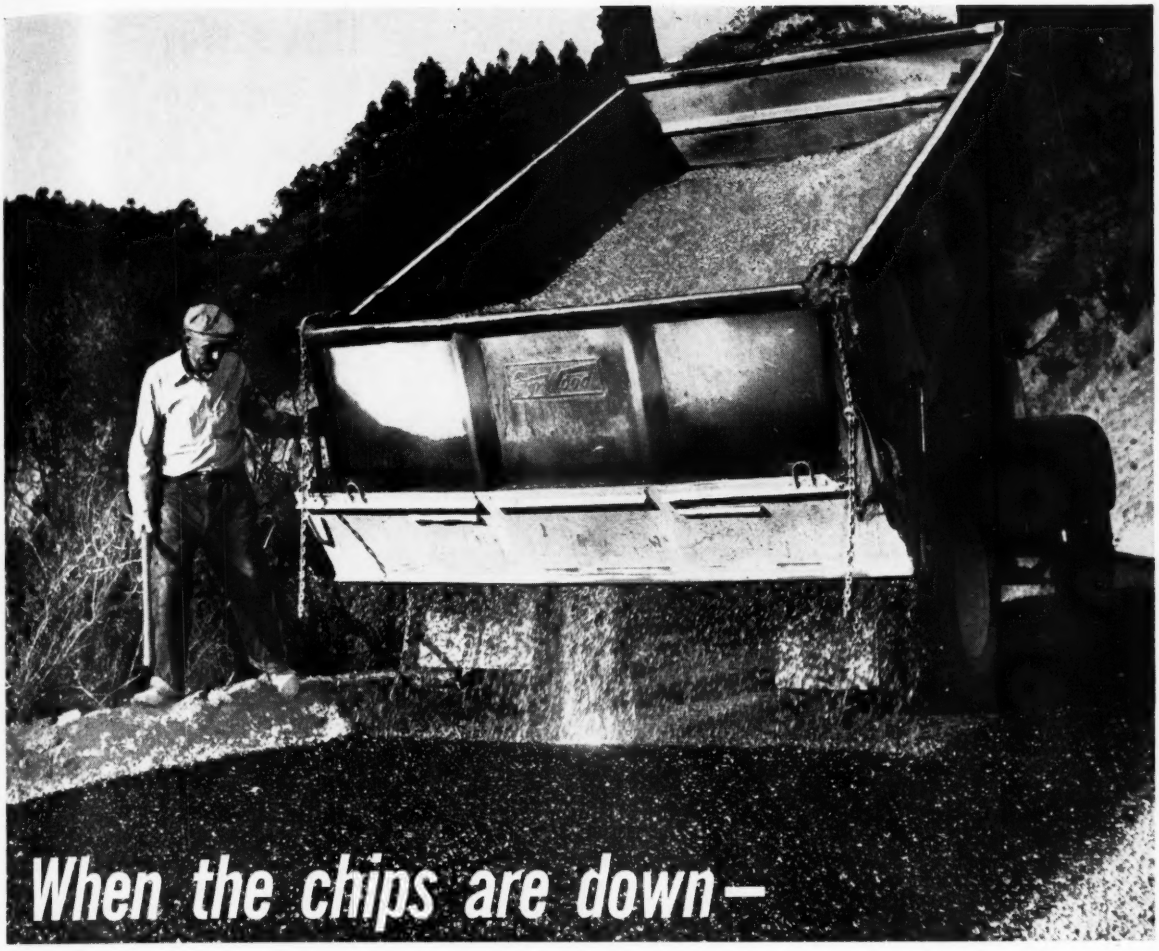
Estimating Production and Construction Costs

A new, comprehensive book by Louis Dallavia has recently been published by the Dallavia Company. The author, a construction estimator by profession, here presents a system that is applicable to a wide variety of job conditions. Based on a set of 160 tables, the system outlined in the book gives basic cost and production data which is then modified according to an index derived from 24 project conditions which include, among other factors, labor, supervision, weather and site conditions. Sections of the book are devoted to earthwork, excavation and moving, reinforced concrete, structural steel, masonry, and rough and finish carpentry. Also included are 12 indexes giving cost and quantity data supporting the tables. (Louis Dallavia Company, 2110 Elmen, Houston 19, Tex., 1954. 257 pp., $15.00.)

Geology in Engineering

The primary purpose of this book is to furnish the civil engineer and engineering student with

(*Continued on page 108*)



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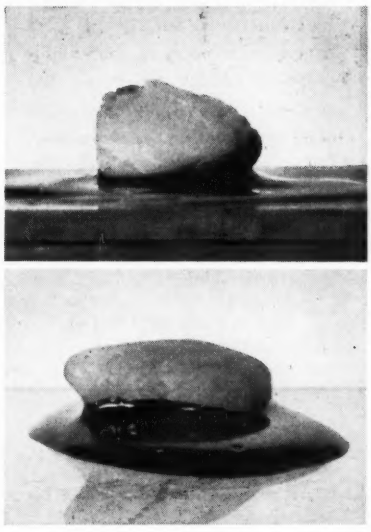

These laboratory photographs show the superior ability of Bitumuls to "wick-up" on the sides of cover chips. Top is a stone put down in an asphalt cut-back; lower, stone put down in Bitumuls.

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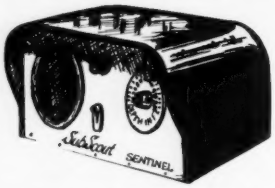

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THE ENGINEER'S CREED

The American Society of Civil Engineers announces the availability of a new supply of "The Engineer's Creed," which originally appeared in the November, 1948 issue of CIVIL ENGINEERING. This new de luxe reprint, 8½ x 11", has been produced on lightweight parchment, and is suitable for framing.

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Please send me . . . copies of "The Engineer's Creed"
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Name .....

Address .....

City .....

Recent Books

(*Continued from page 106*)

the background needed for understanding engineering-geologic reports. The first part of the book deals with various phases of geology most useful to engineers: minerals, rocks, land forms, frost action in soils, earthquakes, etc. Later chapters take up types of engineering projects—dams, reservoirs, tunnels, highways, and airfields—which illustrate the applications of geology to civil engineering. Separate chapters are devoted to soil mechanics and concrete aggregates. John R. Schultz and Arthur B. Cleaves are the authors. (John Wiley & Sons, Inc., 440 Fourth Avenue, New York 16, N.Y., 1955. $8.75.)

How to Estimate for the Building Trades

Carpentry, Lath and Plaster, Air Conditioning, Sheet Metal, Linoleum, Painting, Masonry, Marble and Tile, Electrical Wiring, Plumbing, Glass, Hardware

This practical manual for the estimator, contractor, and builder deals with techniques used in estimating materials and labor for residences and small buildings. To provide the necessary background, the practices of each of the various building trades are described, and information on plan reading, relevant mathematics, specifications, and contracts is included. Authors are Gilbert Townsend, J. Ralph Dalzell and James McKinney. (American Technical Society, 848 East Fifty-eighth Street, Chicago 37, Ill., 2nd edit., 1955. 699 pp., $6.75.)

Knickversuche mit Stahlbetonsäulen Festigkeit und Elastizität von Beton mit Hoher Festigkeit

Deutscher Ausschuss für Stahlbeton, no. 113

The first three parts of this publication by W. Gehler and Alfred Hütter give description and results of two series of buckling tests on thin reinforced-concrete columns, including a comparison of these tests on axially-loaded columns with another series of tests on eccentrically-loaded columns. Part 4 is a separate report by Otto Graf on a series of tests on the strength and elasticity of high-strength concrete. (Wilhelm Ernst und Sohn, Berlin, 1954. 68 pp., DM. 17.00.)

Materials of Construction

Their Manufacture and Properties

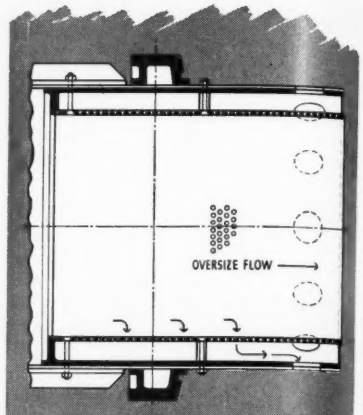
Most of this textbook by Adelbert P. Mills, Harrison W. Hayward and Lloyd F. Rader, consists of a detailed treatment of specific engineering materials and their industrial and structural applications. The entire text has been revised to cover developments since the previous edition published in 1939, and new chapters have been added on mineral aggregates and laminates and adhesives. (John Wiley & Sons, Inc., 440 Fourth Avenue, New York 16, N.Y., 6th edit., 1955. 650 pp., $7.50.)

(*Continued on page 112*)

Library Services

Engineering Societies Library books may be borrowed by mail by ASCE members for a small handling charge. The Library also prepares bibliographies, maintains search and photostat services, and can provide microfilm copies of any items in its collection. Address inquiries to Ralph H. Phelps, Director, Engineering Societies Library, 33 West 39th Street, New York 18, N.Y.

Here's Way To Increase Your Screen Capacity 25%



This Yuba-built Olson trommel mounts in new or old screens, converts usually blanked out space into productive screening area without lengthening screen.

Your screen capacity actually can be increased as much as 25%—without adding to the screen length—by mounting Yuba-built Olson trommels inside your present screens.

Olson patented trommels convert screen space usually blanked out by tread rings and end plates into productive screening area. Plates are taper drilled with holes of size and spacing suited to your requirements. Effective screening is thus extended to full length of your screens. You can get better classification of material, too, through additional perforated area. Effectiveness and freedom from downtime proved by more than five years of field use.

For your present screens or for new ones, Olson trommels, made of abrasion resisting steel plate to fit your needs, can be either field or factory installed. Send details and general arrangement of your screen, hole sizes and spacing needed. Estimates furnished promptly; no obligation.

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IMPROVED MODEL ES 1025 PRECISION DEPTH RECORDER FOR UNDERWATER SURVEY, DREDGING AND OIL EXPLORATION

accuracy ± 3 inches

Three basic ranges 2 to 60/120/180 feet. Optional additional ranges 180′ to 240′, 240′ to 300′; 1 to 60 fathoms, 60 to 120 fathoms, 120 to 180 fathoms—all with automatic 5 foot overlap on each range. Built-in power supply. Built-in controls to correct for temperature, salinity, tide, draft and squat. Remote fix button included. Accuracy ± 3 inches.

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Copperweld* Survey Markers provide permanent, easy-to-locate points of reference that eliminate troublesome disputes. Economical and easy to drive, they can't rot or rust—won't splinter, bend or break. Bronze head can be center-punched and stamped for identification. If larger head is needed, a 4" adapter is available.

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Standard length is 3 feet—other sizes made to order. Packed 10 markers to a carton.

Write for Bulletin 144

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ASCE Hydraulics Division

Berkeley, Calif., Meeting, Aug. 24–26, 1955

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Street and number . . . . . .

Berkeley, Calif.

DEAR SIRS: Please make reservations as follows:

	PRIVATE BATH	SHARE BATH	WITHOUT BATH
Single	c	ac	b
Double	c	ac	b
Twin	c	ac	b

a Available at Hotel Durant only; *b* Available at Hotels Durant and Carlton and International House; *c* Not available at International House

I (we) shall arrive . . . . . ; depart . . . . . ; about . . . . . ; . . . . . .
(*date*) (*date*) (*a.m.*) (*p.m.*)

I enclose my check for . . . . . as deposit on this reservation.
$5 *per person*

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Self . . . . self and wife . . . .
Self and family . . . . . .
Self and other . . . . . .

. . . . . *Name*

. . . . . *Street and number*

. . . .
Please give name *City and state*

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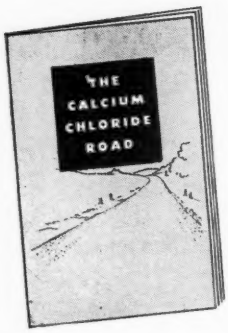
Tells How To Get

SMOOTHER, CLEANER, LOWER COST, EASIER TO MAINTAIN, *UNPAVED ROADS*



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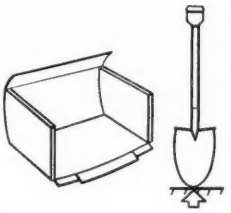
Outstanding, New Allis-Chalmers Earth-Moving Team:

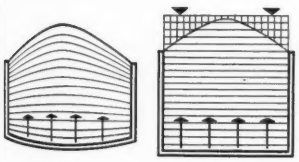
Model 315 scraper, with 20-yd heaped capacity, pulled by an HD-16 Tractor (150 net engine hp with torque converter drive, 131 belt hp with standard transmission drive).

Look At The Dirt-Moving Advantages of Allis-Chalmers Scrapers

Digs in Fast. Curved and offset cutting edge on Allis-Chalmers scrapers concentrates initial digging effort at center for faster penetration — as with a round-end, curved-bottom spade.



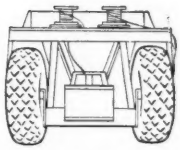
Loads with Less Resistance. Low, wide bowl reduces loading time, requires less power.



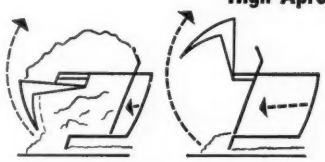
Heaps Loads with a Minimum of Spillage. Combination of deep center cut and correct angling of cutting edge loads the scraper with minimum spillage. "Boiling" action fills voids, produces automatically well-heaped loads.

Hugs the Ground for Stability. The wide, low bowl keeps scraper center of gravity low . . . wide wheel tread adds stability for working on slopes, grades, or rough terrain.

Hauls, Maneuvers Easily. Big, low-pressure tires provide maximum flotation. A short wheel base permits scraper to turn within its own length.

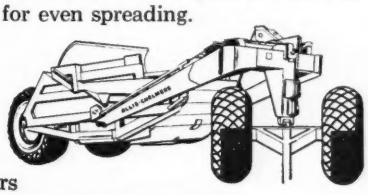


High Apron Lift Prevents Jamming. Apron lift is high — as much as 102 in. in the Model 315. Prevents any possibility of material jamming.



Dumps with Positive Ejection, Spreads Evenly. Ejector forces load forward, wipes bowl clean. Operator can control rate of discharge for even spreading.

Ground Clearance. Front-running gear has ample clearance. High carrying position of bowl enables Allis-Chalmers scrapers to clear ruts, windrows and other obstructions.



Model 315	Model 108	Model 106	Model 44*	Model 24*
15 yd struck 20 yd heaped	8.4 yd struck 11 yd heaped	6.1 yd struck 7.5 yd heaped	4 yd struck 4.7 yd heaped	2 yd struck 2 yd heaped

*Hydraulically controlled

COMPARE Allis-Chalmers scrapers with others, feature by feature, dollar for dollar, and you'll see why they are your best buy in every way.

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SONOTUBE®

FIBRE FORMS

for round columns of concrete

Plant, P. Lorillard Co., Greensboro, N. C. Architects and Engineers: Lockwood-Greene, Engineers, Inc., New York. Resident Engineer: W. C. McDaniel. General Contractor: H. L. Coble Construction Co., Greensboro, N. C.

Lightweight, labor-saving formwork!

...low cost SONOTUBES® make it possible

A total of 220 SONOTUBES were used to form the round concrete columns for this new P. Lorillard plant in Greensboro, N. C. Of these, 164 were of 18" I.D. and the remainder, 22" I.D. Heights of all columns are between eleven and twelve feet.

Low cost SONOTUBE Fibre Forms save time, money and labor . . . take fewer men to handle because they are lightweight . . . take less time to erect because they require only minimum bracing.

SONOTUBES are supplied in specified lengths up to 50' or can be sawed to your requirements on the job. In 26 sizes from 2" to 36" I.D.

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MEXICO: Sonoco de México, S. A., Apartado 10239, México, D. F.

Recent Books

(*Continued from page 108*)

Zur Theorie des Vollkommenen und Unvollkommenen Brunnens

A contribution to the theory of water wells which penetrate the water-bearing formation either fully or only partially. This is a theoretical, mathematical discussion, by Günther Nahrgang which is somewhat condensed from his doctoral thesis. (Springer-Verlag, Berlin 1954. 43 pp., DM. 7.50.)

Positions Announced

Pennsylvania State Civil Service Commission. Vacancies for Building Construction personnel are open in the Bureau of Homes and Hospitals of the Pennsylvania Department of Welfare in Harrisburg. Jobs include inspection of proposed sites and review of plans and specifications for state and federal construction standards. Salary range is from $6,294 to $6,990. The positions involve travel to sites and Pennsylvania residence is required. Minimum requirements include Pennsylvania license as an engineer or architect and seven years of related experience or three years experience and appropriate college training. Application blanks from the State Civil Service Commission, Box 569, Harrisburg, Pa.

The City of Philadelphia. An examination has been announced for a graduate Engineer in Public Health with salary from $4,500 to $5,160. Duties are inspection and investigation in the general enviromental health inspection program, and requirements are a sanitary, civil, mechanical or chemical engineering degree. Philadelphia residence requirement has been waived by the Civil Service Commission. Application blanks from the Personnel Department, Room 127, City Hall, Philadelphia, Pa.

U.S. Department of Agriculture. Two Design Engineering positions are open in the Soil Conservation Service. The first, grade GS-9, pays $5,060 per year, and the other, GS-7, pays $4,580. Both are located in Milwaukee, Wis., and require either an engineering degree or four years of experience. For further information write Charles H. Buell, State Administrative Officer, 3010 E. Washington Ave., Madison 4, Wis.

City of Akron. Position of Sewerage Engineer, with a salary range of $7,694 to $8,348 per year, is open in Akron, Ohio. Under administrative direction, the applicant will be responsible for design, construction, maintenance, and technical operation of sewers and sewerage disposal and other related work. Minimum qualifications are an education equivalent to graduation from a university with specialization in civil engineering and extended experience in the design and construction of sewers and sewerage works. Applicant must be a registered professional engineer in Ohio. Further information may be obtained from Charles F. Bassett, Personnel Director, Civil Service Commission, Dept. of Personnel, 502 Municipal Bldg., Akron, Ohio.

U.S. Army, Fort Belvoir, Va. Bridge Engineers in grades GS-9 to 11 with a salary range of $5,060 to $5,940, are needed at the Engineer Center, Fort Belvoir. Applications for Federal Employment, Standard Form 57, may be obtained from any Civil Service or Army Civilian Personnel Office or Civilian Personnel Office, Employment Division, Building 211, 21st St., the Engineer Center, U.S. Army, Fort Belvoir, Va.

City of Detroit Civil Service Commission. The City of Detroit has openings for Senior Assistant Engineers in Sanitary Design paying $6,287 per year. Duties include work on sanitary design features of water and/or sewage systems, plants and equipment. Also open are two positions as Senior Assistant Structural Engineer: one in road and bridge design, the other reviewing plans submitted for building permits. Further information and applications may be obtained from the Detroit Civil Service Commission, 612 City-County Building, Detroit 26, Mich.

Boeing civil engineers have vital and rewarding jobs

This is the Boeing B-52—mightiest of the world's jet bombers. The "wraps" are off it now. Some of the civil engineers who made vital contributions to its design are now at work on the B-52's further development. Many more have gone to work on other "years-ahead" airplanes and guided missiles. But these new Boeing aircraft are highly classified, and cannot be shown here.

Civil engineers at Boeing have vital jobs in this field. They experiment endlessly to keep up with new and exacting demands. The importance of their art is steadily increasing in structural design, frequently with new materials, in structural development and stress analysis, in structural and flight testing, and in many other phases of Boeing's exciting future.

Boeing engineers can point with pride to recent developments like the B-47 and B-52 jet bombers, the KC-135—America's first jet tanker, and the IM-99 Bomarc pilotless interceptor. These Boeing engineers are now at work on widely diversified projects: rocket, ram jet and nuclear propulsion, supersonic flight, research in new materials, and many more. The result will be planes and missiles that will fly even faster, farther, and higher, and deliver an even greater punch.

These are evidences of Boeing's continuing growth—a growth made possible by uncompromising insistence on engineering excellence. Boeing employs twice as many engineers now than at the peak of World War II. But even more engineers are needed for Boeing's research, design and production teams.

If you want the satisfaction of doing an important job—if you want individual recognition and regular merit reviews—if you want to work with the finest equipment and the pick of the nation's engineers—then it will pay you to investigate career opportunities at Boeing.

• **JOHN C. SANDERS, Staff Engineer—Personnel**
• **Boeing Airplane Co., Dept. D-41, Seattle 14, Wash.**
• Please send further information for my analysis.
• I am interested in the advantages of a career with Boeing.
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• University or
• college(s) _____ Degree(s) _____ Year(s) _____
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This placement service is available to members of the Four Founder Societies. If placed as a result of these listings, the applicant agrees to pay a fee at rates listed by the service. These rates—established to maintain an efficient nonprofit personnel service—are available upon request. The same rule for payment of fees applies to registrants who advertise in these columns. All replies should be addressed to the key numbers indicated and mailed to the New York Office. Please enclose six cents in postage to cover cost of mailing and return of application. A weekly bulletin of engineering positions open is available to members of the cooperating societies at a subscription rate of $3.50 per quarter or $12 per annum, payable in advance.

Men Available

CIVIL ENGINEER; J.M. ASCE; 32; married; two years' experience as cost engineer on hydroelectric project and five years in responsible position as owner's engineer in industrial construction in South America; experienced in field and office work including administrative duties, dealings with sub-constructors. Speaks fluent Portuguese, understands Spanish. Seeks responsible position, will consider any proposal. Location preferred, Southwest, California, or Foreign. C-57.

CIVIL ENGINEER; J.M. ASCE; 31; BSCE 1950; married. Three years in all phases of industrial plant building design; foundations, structural, sewers, architectural, some field layout, grades, inspection. One year highway and railroad relocation design. Desires responsible position with management potential in plant or municipal engineering. Location, Southeast. C-58.

CIVIL INDUSTRIAL ENGINEER; A.M. ASCE; 62; married; 45 years' diversified experience as engineer, including geodetic surveying, general contracting, construction superintending and engineering investigations involving industrial plants, terminal facilities, rapid transit lines cement plants, refineries, hydrocarbon synthesis plant, etc. Liaison engineer in guided missile production and general engineering office duties. Desires full or part time office work. Available now. East Bay or San Francisco. C-59-SF-519.

HYDRAULIC AND SANITARY ENGINEERING; A.M. ASCE; single; MSCE; registered P.E. Nine years' comprehensive experience in consulting engineering field in responsible charge various phases of investigation, design, and construction of water supply, sewerage, and drainage facilities, public works and industrial. Presently employed. Free to travel or relocate; U.S. or foreign locations. C-60.

CONSTRUCTION ENGINEER; J.M. ASCE; MIT graduate; age 26; married. Presently officer in Navy CEC. Civilian experience in industrial construction. Outstanding academic record. Desires permanent position with building contractor in East or South. Willing to relocate. Will be available August 1. C-61.

Positions Available

INSTRUCTOR OR ASSISTANT PROFESSOR; M.S. in civil engineering; to teach surveying, soil mechanics, fluid mechanics and normal civil engineering laboratories. Should be active in technical and professional organizations. Salary and academic rank open. Position starts September 1955. W-868(a).

ENGINEERS; (*a*) Chief Design Engineer; C.E.; with at least ten years' design and administrative experience on highways and bridges. Salary, $10,000–$12,000 a year. (*b*) Senior Designer; C.E.; with at least eight years' drainage and highway location experience. Salary, $7,000–$8,000 a year. (*c*) Structural Designer; C.E.; with at least three years' highway or bridge experience. Salary, $5,000–$7,000 a year. Location, New York, N.Y. W-1294.

TOWNSHIP ENGINEER; Must be a registered engineer and familiar with the construction and maintenance of roads. Location, Pennsylvania. W-1509.

DESIGNERS; (*a*) Designer; civil engineering graduate; with at least five years' concrete experience; to design and lay out foundations for steel mill equipment. (*b*) Architectural Designer; with five years' industrial building experience. Salaries, $6,600 a year. Location, New York, N.Y. W-1510.

JUNIOR ENGINEERS; for utility system; B.S. in mechanical, electrical, civil, chemical and petroleum engineering; preferably with military service. Company has a training program of from one to one and a half years in field of interest. Salaries, $4,200–$4,800 a year to start, with increments at the end of six months and one year. Locations, Ohio and West Virginia. W-1539.

EDITOR; graduate civil engineer; with some construction experience and some editorial experience for a construction publication. Salary open. Location: several months in New York City before transfer to Midwest to assume position of Editor-in-Chief. W-1540.

INSTRUCTOR; civil engineering; B.S. or M.S. degree. Must be well qualified both by practical experience and teaching experience to teach at college level. Salary, $4,800 a year and up; three-year contract. Transportation paid for instructor and wife. Salary tax exempt. Location, Foreign. F-1544.

DESIGNERS; 30–40; graduate civil; for the designing of highway bridges and structures; knowledge of geometrics and road design. Salary open. Location, Ohio. W-1552.

CONSTRUCTION SUPERINTENDENT; to supervise and lay out work on industrial buildings. Salary open. Locations, Queens, New York. W-1558.

JUNIOR ENGINEERS; civil or mechanical; for drafting, office and field engineering covering gasoline stations and bulk terminals. Salaries, $4,800–$5,400 a year. Location, New York Metropolitan area. W-1569 (b).

ASSOCIATE PROFESSOR; civil graduate; M.S. degree; with some teaching experience; to head the Civil Engineering Department. Salary, $4,800 per 8½ months school year. Location, Pennsylvania. W-1581.

FABRICATED STRUCTURAL STEEL AND PLATE ESTIMATORS

Large Southern fabricator has openings for fabricated structural and/or plate estimators familiar with field erection costs. Preferably engineering graduates with two years practical experience. Forward resume with salary expected to:

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Civil Engineering

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All replies will be confidential

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Opportunity for full time or part time employment on government contract while working for an advanced degree in physical or mechanical metallurgy. Graduate study and remuneration commensurate with research duties. Apply to Department of Metallurgy, The Technological Institute, Northwestern University, Evanston, Illinois.

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available to students with degrees in science or engineering and an interest in physical or mechanical metallurgy. Apply to Department of Metallurgy, The Technological Institute, Northwestern University, Evanston, Illinois.

Department of Metallurgy
The Technical Institute
NORTHWESTERN UNIVERSITY
Evanston, Illinois

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Designers
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For office work on highways, expressways and bridges. Long term project. Desire experience or training including alignment and profile computations, geometric design of interchanges and associated work.

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WANTED:
ASS'T TRAFFIC ENGR.

For traffic engineering department just recently established. Salary range $537 to $620 a month with maximum salary obtainable through annual and longevity increases. Registration as a professional engineer required. Applications accepted until the needs of the service are filled.

Write Personnel Department, City Hall, Madison 3, Wis.

CIVIL ENGINEERS. (*a*) Chief of Party; with at least five years' property, topographical and heavy construction survey experience. Salary, $6,500 a year. (*b*) Transitman; for property survey, topographical, line and grade, etc. Salary, $4,420–$5,200 a year. Location, northern New Jersey. W-1592.

OFFICE ENGINEER; to 30; preferably Civil graduate interested in office engineering and estimating, specs writing, etc.; for firm of steel designers and fabricators. Salary, $5,200 a year. Location, New York, N.Y. W-1598.

MUNICIPAL ENGINEER; young; civil graduate interested in municipal work; preferably with a few years' experience. Duties include design, development of improvements in operating methods. Salary open. Location, northern New Jersey. W-1599.

RESIDENT ENGINEER; graduate civil; with broad background and experience in highway with bridge work. Salary, to $10,000 a year. Location, Ohio. W-1613.

DESIGN ENGINEER; civil; experienced in the design of airfield pavements. Apply by letter indicating qualifications, salary expected and when available. Location, South. W-1617.

CIVIL ENGINEERS; (*a*) City Engineer and Superintendent of Public Works; graduate; with at least ten years' responsible experience in design construction and maintenance of public work. Salary, $6,710–$7,670 a year. (*b*) Civil Engineer; Grade II; graduate; with at least three years' experience in public works or related work. Salary $4,220–$4,820 a year. Location, New England. W-1618.

INSTRUCTOR; in civil engineering; Master's degree preferred; to teach general engineering science and civil engineering subjects. Salary, $3,600–$3,900 for nine months. Location, West. W-1619-SFO.

ASSISTANT ENGINEER; civil graduate eligible for registration as a civil engineer or land surveyor; under 40. Duties will include preparation of subdivision surveys, street plans and profiles, water and sewer plans and specifications, coordination of work of two or more survey parties. Must be citizen. Salary, to start, $5,200 a year. Virginia. W-1621 (b).

CONSTRUCTION ADMINISTRATOR; 45–50; graduate civil; with fifteen years' experience in the design and construction of processing plants, warehouses stores, office buildings; to plan, organize and direct a 75 million dollar annual construction program. Salary open. Location, New York, N.Y. W-1629.

CIVIL ENGINEER; to 65, who is retired, to appraise and make physical inspections of commercial buildings in the New York Metropolitan area. Salary, $4,200–$4,500 a year. W-1641.

TRAINEES; mechanical, chemical or civil engineering graduates for engineering and production duties in cement mills. Location, Midwest. Salary, $4,368 a year. W-1648 (a).

ASSISTANT PROFESSOR; preferably with M.S. degree; to teach any branch of civil engineering. Salary open. Location, East. W-1651.

ENGINEERS; (*a*) Structural Designer; civil graduate; with at least five year's steel and concrete experience on industrial and general building construction. (*b*) Design-Draftsman; civil graduate; with building construction experience for layout and detail of steel and concrete structures. Salary open. Location, New York, N.Y. W-1681.

SANITARY ENGINEER; sanitary or civil graduate with at least two years' experience in application or operation of sewage treatment equipment. Duties will include application work on sewage and waste treatment equipment for manufacturing of pumps. Salary up to $7,400 a year. Employer will negotiate fee. Location, western Chicago suburb. C-2973.

SENIOR & JUNIOR SALES, DESIGN-STRUCTURAL STEEL; civil or aeronautical graduate; Senior—30–45; Junior—25–35; well qualified by education, experience, personality and aptitude to promote the use of structural steel. Will contact architects, engineers, builders and users. Qualified to design, fabricate and use steel, able to address groups and establish good public relations. Senior to $8,000; Junior to $6,000 a year. Travel San Francisco area for Senior; Los Angeles area for Junior. Employer will negotiate fee. Apply by letter with resume. S-117.

AIRCRAFT ENGINEERS
With Experience
WANTED AT
GRUMMAN

LAYOUT DESIGNERS
Airframe Structures

FLIGHT TESTING
Planners
Analysts

HYDRAULICS
Systems Design
Testing

STRUCTURES
Stress Analysis

RESEARCH
Computer Engrs. Digital or Analog
Vibration & Flutter Engrs.
Dynamic Analysis—Systems Engineers

ARMAMENT INSTALLATION
AERODYNAMICS
INSTRUMENTATION

TOOL DESIGNERS

Recent Graduates with Aeronautical, Mechanical, Civil or Engineering Physics Degrees may qualify.

Proof of U. S. Citizenship Required
APPLY IN PERSON
OR SEND RESUME TO:
Engineering Personnel Dept.
INTERVIEWS AT
Employment Office
South Oyster Bay Road
North of Railroad
Monday thru Friday
8:30–11:30 AM; 1:30–3:30 PM

GRUMMAN AIRCRAFT
Engineering Corp.
Bethpage, N. Y.

Applications for Admission to ASCE, May 14–June 11, 1955

Applying for Member

DONALD MCCLELLAN BELYEA, Port Huron, Mich.
JOHN BOLTON, Washington, D.C.
LEWIS BERNARD BONE, Houston, Tex.
ANDREW F. CAPUTO, New York, N.Y.
BRIAN HUGH COLQUHOUN, Washington, D.C.
JAMES RALPH WILLIAM CREWES, London, S.W. 1, England.
JOHN LAWRENCE DONOGHUE, Chicago, Ill.
GEORGE ADAM EDINGTON, Kenya, Africa.
HARRY BAILEY FENTON, Columbus, Ohio.
ALEXANDER WARNER FREED, JR., Seattle, Wash.
ARTHUR HOUSTON FRYE, JR., Los Angeles, Calif.
FRANK ERSKINE HALLUM, San Antonio, Tex.
FRIEDRICK KARL HARTUNG, Dortmund, Germany.
ROBERT WALTER HAUSSLER, Los Angeles, Calif.
WILLIAM BENNETT HENDERSON, Kingsport, Tenn.
KAZOU BERT HIRASHIMA, Honolulu, Hawaii.
FRED OSCAR JONES, Spokane, Wash.
MILTON KELLERT, Silver Spring, Md.
ALBERT THOMAS KNUCKEY, Denver, Colo.
CURT HENRY MAUTHNER, New York, N.Y.
PHILIP MYRON NOBLE, Eltopia, Wash.
MAXWELL E. NOECKER, Indianapolis, Ind.
GEORGE WILLIAM REED, Yuba City, Calif.
GENE ERNEST SCHOLZE, St. Paul, Minn.
JOHN ZUREK, Indianapolis, Ind.

Applying for Associate Member

HENRY RUSSELL SHAW ABREY, Transvaal, S. Africa.
JAMES BRADER ARBUTHNOT, Colombo, Ceylon.
SOLIE JAL ARCEIVALA, Cambridge, Mass.
CLIFTON EARL BAKER, Los Angeles, Calif.
ENIS YAKUP BASKAM, New York, N.Y.
ALBERT JOHN BLAHA, Port au Prince, Haiti.
STERLING LOWE BUGG, Port Hueneme, Calif.
NATHAN CLIFFORD BURBANK, JR., Cambridge, Mass.
RICHARD SIGMUND CEBULA, Olympia, Wash.
HERBERT EDGAR COBURN, San Diego, Calif.
HENRY MICHAEL GREIG COCKBAIN, Norwich, England.
BERNARD CORDEN, San Leandro, Calif.
HENRY JACOB COWAN, Sidney, Australia.
DAVID JACK DAYTON, Oakland, Calif.
ARISTOPHANIS DELPHOS, New York, N.Y.
GENE THOMAS EBERLE, Milwaukee, Wis.
LOUIS GARNER ELSERK, Kansas City, Mo.
ALECK SMITH EVANS, Maracaibo, Venezuela, S.A.
CHUAN-CHUNG FENG, Columbia, Mo.
DSO YUN FOK, New York, N.Y.
ROBERT IVES GILCHRIST, Anaheim, Calif.
RENE EMBREE HAMMOND, New York, N.Y.
HENRY CHARLES HOLLINGER, Ada, Ohio.
MICHAEL JAMES JANNER, New York, N.Y.
WALTER FORREST JOHNSON, Sacramento, Calif.
YASUO KAWANO, Tokyo, Japan.
THOMAS RALPH MACKENZIE, Princeton, N.J.
WILLIAM JOHN MACKO, Stratford, Conn.
AFTAB AHMAD KHAN MALIK, Risalpur, Pakistan.
KENNETH BURTON MCINTIRE, Vernon, Calif.
WILLIAM CLARENCE MCNEILL, JR., Nashville, Tenn.
HUGH DONALD MCNIVEN, New York, N.Y.
WILLIAM ARTHUR MILEK, JR., Omaha, Nebr.
JAMES PATRICK NOLAN, Baltimore, Md.
GEORGE MITCHELL NORMANDY, Atlanta, Ga.
CASTRO MARIO MENDES de OLIVEIRA, Rio de Janeiro, Brazil.
BENJAMIN OPEROWSKY, New York, N.Y.
ARTHUR LEE POND, JR., Richmond, Va.
JVAN BAHADUR PRADHAN, Kathmandu, Nepal.
ANDREW WILSON ROSS, Tucson, Ariz.
DEV RAJ SIKKA, Madhya Bharat State, India.
ALEJANDRO OSCAR SOLARI, Rio de Janeiro, Brazil.
JAGDISH RAJ SONDHI, Kenya, East Africa.
DAVID EUGENE STEVENS, Oklahoma City, Okla.
WILLIAM MAXWELL STUBBLEFIELD, San Francisco, Calif.
ALBERT SWITZER, Jackson, Miss.
EDWIN MORTON THAYER, Sanford, Me.
CHARLES ROBERT VARNDELL, Baltimore, Md.
EDUARDS VENTERS, Lafayette, Ind.
HUBERT JOSEPH WILLIS, New York, N.Y.

Applying for Affiliate

JOHN PERSHING, New York, N.Y.

Applying for Junior Member

DOUGLAS RAYMOND BOYNTON, Roanoke, Va.
THOMAS FRANCIS BRITT, Davenport, Iowa.
WILLIAM FRANCIS DUFFY, Dedham, Mass.
GEORGE STEVE GEORGE, Boston, Mass.
GEORGE LESLIE HOAG, Pleasanton, Kans.
VIACHISLAF NICHOLAS JACOBSON, Vancouver, B.C., Canada.
JOSEPH HAROLD LENNEY, Boston, Mass.
GLENN JAMES MUIR, Van Nuys, Calif.
ORLO CHARLES PACIULLI, JR., Vienna, Va.
CHAUNCEY HARRIS PATTERSON, JR., Fairfax, Va.
MAYNARD OTTO SERBOUSEK, Minneapolis, Minn.
RICHARD EMERSON SLYFIELD, Sacramento, Calif.
PATRICK JOSEPH SORRENTINO, Montreal, Quebec, Canada.
MAITLAND ALLEN STEELE, Baton Rouge, La.
ALEXANDER SURKO, JR., Princeton, N.J.
CHARLES POWELL WRIGHTSON, San Francisco, Calif.
KHIN MAUNG YIN, London, England.
YOSHIAKI YOSHIMI, Tokyo, Japan.

[Applications for Junior Membership from ASCE Student Chapters are not listed.]

FLORIDA

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Limited number permanent positions open for experienced highway planning personnel for work in following classifications and pay scales.

Senior Designers	**6000 - 7200**
Traffic Engineers	**6000 - 7200**
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Cartographer	**5300 - 6600**
Designers	**4800 - 6000**
Draftsmen	**3600 - 4800**

Only those with excellent qualifications and experience need apply. Experience necessary in one or more of following classifications: Urban street design, expressway design, rural highway design; comprehensive traffic studies and analysis; engineering cost analysis; long range highway planning; drafting pertaining to contract plan preparation for rural and municipal highway projects.

Positions open in Tallahassee, Chipley, Bartow, Lake City, Fort Lauderdale, DeLand and Daytona Beach. Excellent working conditions; retirement plan, sick leave with pay, paid vacations, hospitalization plan available. Apply to State Highway Engineer, State Road Department, Tallahasse, Flordia.

STRUCTURAL DESIGNERS & DETAILERS

Prefer CE or Arch E with several years' experience in bridges, industrial buildings, or pressure vessels and heavy ducting. Will consider lesser experience with good educational background in structural analysis.

Unusual engineering opportunities exist in our well established firm in connection with the design, construction supervision and inspection of a wide variety of engineering projects in both concrete and steel. Included are bridges, industrial buildings, advanced test facilities and other construction of an industrial nature, and various types of highway work.

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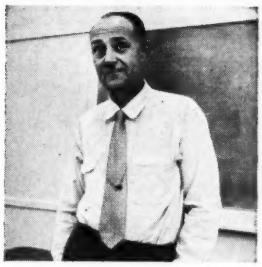
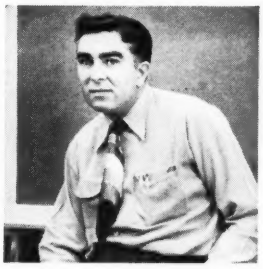


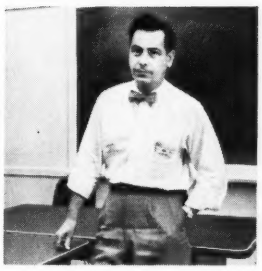
A question often asked:

Me...an Aircraft Design Engineer?

A question often answered:

Yes, Lockheed in California trains you—at full pay





Three engineers who have made the transition to Aircraft Design through Lockheed's Training Program: E. A. Phelps (top) was a Structural Steel Engineer in Denver, Colorado; H. G. Hauser (center) was a Test Equipment Design Engineer in Grand Rapids, Michigan; R. W. Tetamore was a Mechanical Engineer in Rochester, N. Y.

Engineers find the step up to Aircraft Design an interesting, rewarding experience in Lockheed's Training Program for Design Engineers.

It's a program adapted to the individual. It adapts you to Lockheed—and Lockheed to you. For the program not only trains you for Aircraft Design, it enables Lockheed to assess your special abilities, assign you to the project best suited to your talents.

Aircraft engineering experience is not necessary to qualify. Lockheed is interested in your knowledge of engineering principles, your aptitude, your experience in other engineering fields.

In the program you receive extensive orientation. When necessary you attend Lockheed engineering classes. You engage in on-the-job training. You learn to work with closer tolerances. You become more weight-conscious. You learn that fresh thinking, new ideas are welcomed and rewarded.

Your program may take three weeks—or three months. It depends on your experience and assignment.

After the Training Program is completed

you join the most diversified Design effort in the history of Lockheed.

46 major projects are in motion—including turbo-prop and turbo-jet transports, vertical rising aircraft, jet trainers, extremely high-speed fighters, bombers, nuclear applications to aircraft.

In career terms this diversification means more scope for your ability; more opportunity for promotion; more job security with so many projects in progress.

You are invited to write for more information on Lockheed's Training Program for Design Engineers. Address: Dept. DE-1-7 E. W. Des Lauriers, Design Engineer Training Program, Lockheed Aircraft Corporation, Burbank, California.

Now in effect: Increased salary rates • Increased overtime scales • Increased employee benefits • A travel and moving expense program that enables you and your family to move to Lockheed in California at virtually no expense or trouble.

Lockheed

AIRCRAFT CORPORATION

CALIFORNIA DIVISION

BURBANK

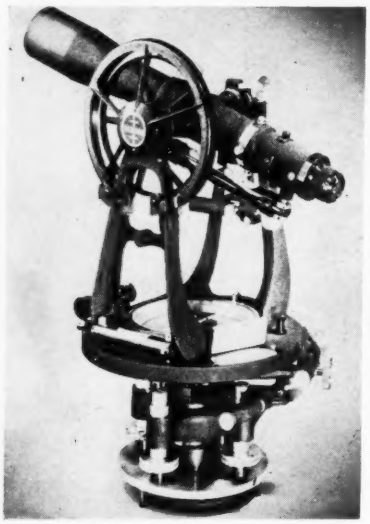
California

EQUIPMENT, MATERIALS and METHODS

NEW DEVELOPMENTS OF INTEREST AS REPORTED BY MANUFACTURERS

Bronze Transit

A 1955 BRONZE ENGINEERS' TRANSIT LINE FEATURES AN OPTICAL SYSTEM WHICH PROVIDES PRECISE STADIA READINGS at greater distances and a clear, well-defined image. Telescope in the $6\frac{1}{4}$ in. model is 26-power with coated optics and has a resolving power of $3\frac{1}{2}$ seconds,



Provides Precise Stadia Readings

effective aperture of 1.430 in. and field of view of 1 degree, 6 minutes. By the use of an integrated rear bearing and eyepiece mount, smooth focusing can be obtained. The object is easily brought into sharp focus with a negative lens actuated by a fine rack and pinion, and with a slow, even motion. Fully enclosed nickel silver leveling screws, fitted into replaceable bronze bushings, are now standard. **C. L. Berger & Sons, Inc., CE 7-118, 37 Williams St., Boston 19, Mass.**

Sonic Analyzer

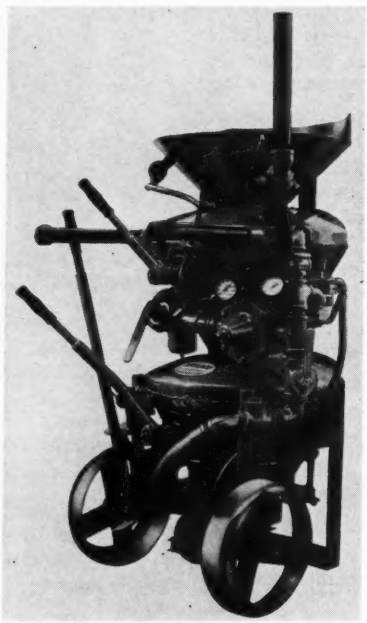
THE E-SCOPE IS A SONIC ANALYZER FOR NON-DESTRUCTIVE TESTING of solid and visco-elastic materials. It features unusual accuracy in providing measurement of effects of natural or induced deterioration, flaws or inclusions, or product uniformity. It is a self-contained instrument designed for laboratory use, field testing or production quality control. The E-Scope permits sonic testing of glass, wood, metals, plastics, tile, brick, carbon, graphite, ceramics, adhesives, rubber abrasive wheels. It meets ASTM specifications for testing concrete. **Kinetic Instrument Co., CE 7-118 Highland Park, Ill.**

Earth Augers

THE ADDITION OF THE PENGO 6 IN., 7 IN. AND 8 IN. DIAMETER HEAVY DUTY FLIGHT AUGER has been made. It is the only series of small diameter heavy duty earth augers on the market today, according to the manufacturer. These heat-treated Manganese Moly alloy cast steel augers are being produced to fill a need for a small diameter auger for use with earth boring machines. **Petersen Engineering Co., Manufacturers, CE 7-118, Santa Clara, Calif.**

Concrete Gunning Machine

IN HANDLING LARGE QUANTITIES OF CONCRETE, the complete range of operating capacities of the Nucretor makes this machine useful for any size job. It is possible to gun extremely wet materials. Exceptionally large clearance in the feed mechanism permits larger operating capacity without increasing the over-all size of the machine. The ball-type slide valves are easy to operate and have their own pressure seals. Among other features

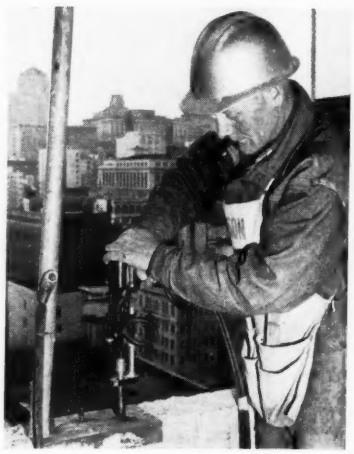


Nucretor

of the Nucretor are: readily accessible controls; easy maintenance and clean-up after operation; light weight. **Air Placement Equipment Company, CE 7-118, 1009 West 24th St., Kansas City 8, Missouri.**

Stud Welding

7500 WELDING STUDS ARE HOLDING TOGETHER THE WINDOWS OF SAN FRANCISCO'S NEW SKYSCRAPER, the Equitable Life Assurance Building. Stud welding the aluminum window wall panels enabled architects to utilize specially-designed, pre-assembled aluminum window-and-facing units with both utilitarian and decorative



Study Welding Method

functions. During construction of the building, steel inserts were cast in the top and bottom of the concrete poured around the structural spandrels and standard threaded studs, $\frac{3}{8}$ in. by $1\frac{1}{4}$ in., were end welded to these inserts. A total of 7500 studs, installed with a welding gun, was used to fasten angle clips to which the window units were then bolted. A battery unity was used for power and a large steel tube was fastened to the ground cable of the welder and placed against the metal inserts in the concrete. The stud welding method permitted an accurate and economical fastening job. **Nelson Stud Welding Division, Gregory Industries, Inc., CE 7-118, Lorain, Ohio.**

Dynamometer

ONE OF THE MOST COMPACT INSTRUMENTS OF ITS KIND, THE PIAB DYNAMOMETER, is now available from stock in the United States and Canada. Following a complete engineering evaluation study, one of America's foremost testing laboratories said, "The prime attribute is compactness . . . ruggedness. It is a well constructed instrument . . . based on a sound engineering principle and design . . . accurate to within 1%. The small recessed window is safe from damage." Accu-

racy is retained in the basic construction principle of this Swedish instrument. Annular conical springs of high compressibility are used with extreme long life due to the very short pull rod movement. Elimination of spring fatigue means that no calibration curve is required throughout the life of the instrument. The measuring indicator dial is supported on anti-friction ball bearings. The PIAB Dynanometer, in use throughout Europe for some time, is available in capacities from 500 to 80,000 lbs. Types L, C and D (up to 2000 lbs.) are only 9 in. long and weigh 3.2 lbs. **The Walpole Company, CE 7-118-119, 419 Boylston St., Boston 16, Mass.**

Lift Truck With Panoramic View

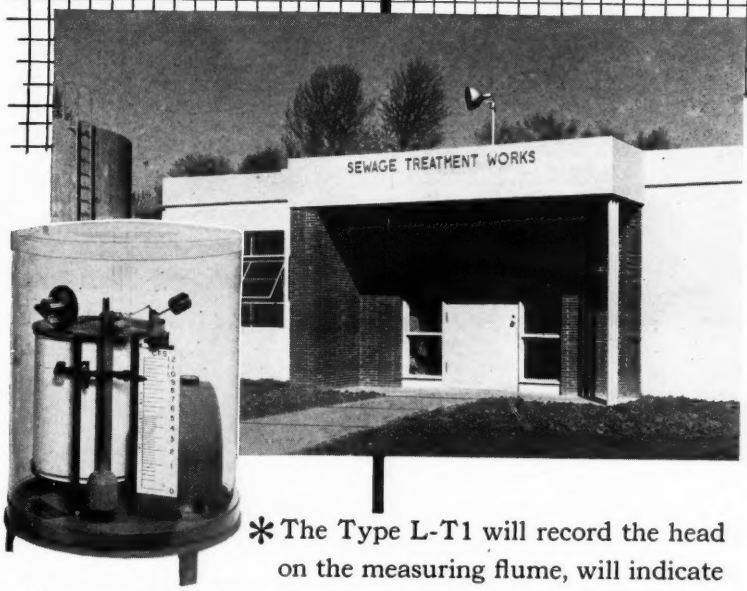
BEING INTRODUCED THIS MONTH IS A REVOLUTIONARILY-DESIGNED LIFT TRUCK consisting of one mast. The Monomast creates panoramic visibility impossible previously because of the conventional upright assemblies. The unit consists of two box-type sections, one telescoping within the other. This allows the operator a clear, unobstructed view to both forks and load, permitting faster operating speed and reducing driver fatigue. Total weight of the Monomast upright is about the same as standard type assemblies, but its tubular design is acknowledged to be stronger than comparable models. Torsional rigidity in the mast has been increased 80% and mast deflection reduced 50% over

Monomast

conventional upright or mast assemblies, it is claimed. The Monomast design allows a 15% increase in hoist speed. Load raising speed is now 58 ft per minute with a corresponding increase in load lowering speed. Slight horizontal carriage flotation is a desirable feature which permits the lift truck to angle back out of tight positions after load depositing. **The Hyster Company, CE 7-119, 1003 Myers St., Danville, Ill.**

PROBLEM:
To obtain at minimum cost the essential information on flow required for efficient operation of a small sewage treatment plant.

SOLUTION:
Stevens Type L-T1 Recorder*



*The Type L-T1 will record the head on the measuring flume, will indicate the volume of flow for any time interval and will give an instantaneous reading of the rate of flow. The head record, made on convenient rectangular coordinates, is basic information for permanent record from which plant operators and State Sanitary Engineers can check flows and volumes. The volume reading from the totalizer dials and the rate of flow indicator are essential for intelligent operation. Readings can be made in any desired volume and flow units.

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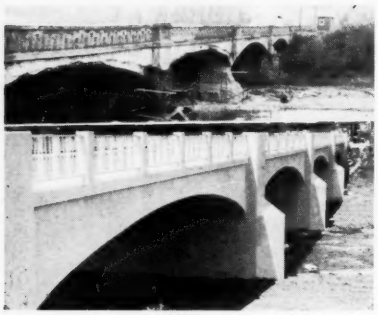
for

Bridge Reconstruction and Repairs

Before



After

What "Gunite", the versatile material, did for this bridge, it can do for any structure in need of repair.

This four span spandrel filled arch bridge over 40 years old was in an advanced stage of disintegration and authorities were considering its demolition and replacement with a new structure. In the interest of economy "Gunite" repair was chosen. All disintegrated concrete was removed and the bridge completely restored and improved in appearance at one fourth the cost of a new structure.

Let our engineers assist you in your concrete bridge maintenance problems.

Engineers: For detailed information on "Gunite", the versatile repair material for all types of concrete structures, send for our 48 page bulletin. Please use the coupon. Mail to

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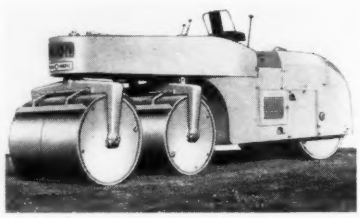
EQUIPMENT MATERIALS and METHODS

(continued)

3-Axle Tandem Roller

A 3-AXLE TANDEM ROLLER FEATURES ROLL-O-MATIC TORQUE CONVERTER DRIVE as standard equipment. The torque converter drive differs from a fluid coupling drive, since a fluid coupling transmission requires a manual gear shift mechanism, and the coupling itself never multiplies



Roll-O-Matic

engine power. Without gear shift mechanism, this drive automatically multiplies the engine driving force by means of oil in motion. The roller has a variable weight range from 14 tons to 20 tons, fully ballasted with water. In addition to the main compression or drive roll, it has twin guide rolls with synchronized hydraulic steering. **The Galion Iron Works & Mfg. Company, CE 7-120, Galion, Ohio.**

Built-Up Roofs

AQUADAM BUILT-UP ROOFS ARE NEWLY DEVELOPED ROOF SPECIFICATIONS for decks varying from dead level to low inclines of $\frac{1}{2}$ in. per ft. The roofs built up with asbestos felts will be smooth surfaced. Those built up with rag felts will be gravel surfaced. The use of asphalt impregnated roofing felts plus a special asphalt cement are combined to create new advantages in the field of bituminous based built-up roofs. The element which differentiates an Aquadam Built-Up Roof is the special Aquadam cementing agent. Among cements derived from bitumens, such as asphalt or coal tar pitch, Aquadam cement is claimed to have greater resistance to cracking and better self-healing properties; higher adhesiveness for stronger bonding between felts and firmer holding of gravel; greater resistance to water and better weathering characteristics throughout. And, during application, Aquadam cement is said to show greater kettle stability and flow properties which assure easier mopping and better coverage. **Johns-Manville, CE 7-120, 22 E. 40th St., New York 16, N. Y.**

Exactly what job needed

FOSTER RENTAL PILING

Prompt and exacting Piling Service from Foster helped speed-up construction of the foundation for the new science hall on the University of Pittsburgh campus.

Pile driving contractors Equipment & Supplies, Inc. got exactly what was needed for the job—by renting specific lengths of MZ-27 steel-sheet Piling—and, at the same time, renting 10" H-Bearing Pile which was used for waling and supports.

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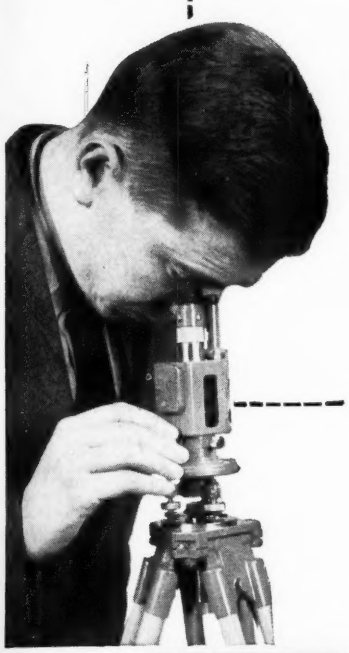

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Weighs only 7 lbs. including "thermos bottle" container and extension-leg tripod.

Prism underneath telescope gives vertical range of 72°

TELESCOPE: Upright image, 5x magnification, field of view 8°

READING: Horizontal circle to 1', vertical to 2'

PRICE: $245.00 incl. metal container and extension tripod with small plumb-bob

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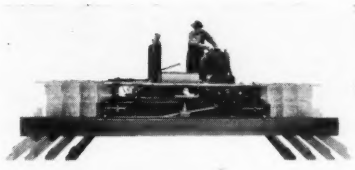
EQUIPMENT MATERIALS and METHODS

(continued)

Finishing Machine

FOR THE FIRST TIME, A MECHANICAL FINISHING MACHINE WILL WIDEN WITH a flick of a finger directly from the operator's stand. This will enable road builders to save time in finishing interchanges, intersections, passing areas, pull-off areas or wherever the width of a highway varies. Forms must be set to follow the actual path of the finished roadway and the concrete is then poured. The frame of the Flex-Plane Self-Widening Finisher, widens rather than the wheels, and completes the job. A triple-lap frame gives the machine utmost rigidity even when completely expanded. **The Flexible Road Joint Machine Co., CE 7-121, Warren, Ohio.**



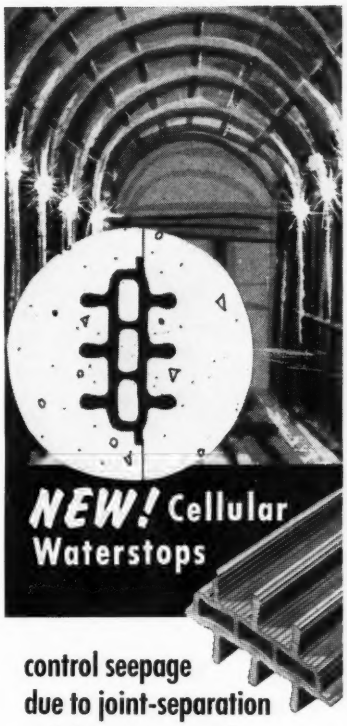
Flex-Plane-Finisher

Vibrating Screen

SUITED FOR DEWATERING HIGH CAPACITY LOADS AND SIZING OF MATERIAL where headroom is limited is a horizontal vibrating screen of new design. It has a lower silhouette, although all advantages of high-intensity straightline action are retained. The Straightline screen has two vibrators, one mounted on each side of the screen at deck level for ease of inspection. Both are located at the center of gravity, so that uniform vibration is assured. They do not project above the side plates; thus headroom is held to a minimum. Straightline screens are available in sizes from 4 by 8 ft to 6 by 20 ft with either one or two decks. **Link-Belt Company, CE 7-121, 307 N. Michigan Ave., Chicago 1, Ill.**

Concrete-Rubber

LIQUID RUBBER PLUS A SPECIAL CEMENT POWDER GIVES INDUSTRY A CONSTRUCTION MATERIAL that resists breakdown under heavy use. Called Laticrete, this combination not only yields without cracking under great pressure, it also dampens shock and noise, resists alkalies and mild



control seepage due to joint-separation or joint-movement!

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EQUIPMENT, MATERIALS and METHODS

(continued)

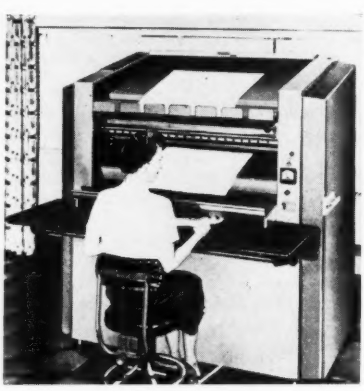
acids, is waterproof and has a non-slip quality. The concrete-rubber mix is a surface coating and can be used in repair work or new installations. It has good adhesion to concrete, metal and even glass. A quarter-inch layer, the suggested thickness, will support heavy loads, such as fork lift trucks, when put down over a hard base. Laticrete, coming in the powder and liquid rubber parts, is prepared like regular concrete. Standard masonry equipment is used both to mix and apply it. One of its requirements is that it can only be applied to a clean surface. Any acid on the surface to be coated must be neutralized before putting down the surfacing material. Otherwise it is handled like concrete or mortar and can be troweled or buffed to give a smooth surface. In development for the past six years, the material is now being evaluated by approximately 60 companies. Tests show that the material hardens in a few hours and can be used after two or three days of curing. About two-thirds as hard as concrete, it will take compressive loads of 2,500 pounds per sq. in. **Naugatuck Chemical Division, United States Rubber Company, CE 7-121-122, 132 Elm St., Naugatuck, Conn.**

Pneumatic Sponge Pump

NO PRIMING IS NECESSARY FOR THE PNEUMATIC SPONGE PUMP which needs only an air compressor to begin work. This self-contained pump requires connecting to a 105 or 125 c. f. m. air compressor and water discharge hose. An exhaust pipe prevents muck and water from entering the motor and the length of this exhaust can be extended as required. The BJ 2½"L Pneumatic Sponge Pump is a vertical, single stage, centrifugal pump driven by a rotary air motor built to operate on compressed air at pressures ranging from 60 to 100 pounds per sq in. and air consumption from 57 to 99 cubic ft per minute. This high-lift sump pump was developed to operate against heads of 7 to 76 cubic ft and capacities up to 380 gallons per minute. The rotary air motor is equipped with a governor and has a variable speed control. An oiler is attached with ample capacity for ten hours operation. **Byron Jackson Co., Pump Division, CE 7-122, P. O. Box 2017, Terminal Annex, Los Angeles 54, Calif.**

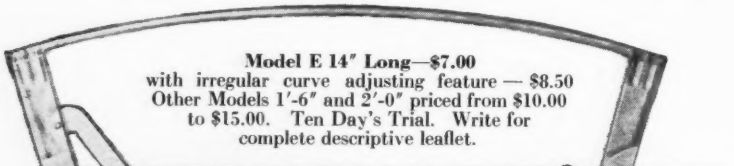
Reproduction Machine

DESIGNED FOR HEAVY-VOLUME USE IN THE ENGINEERING, DRAFTING AND ARCHITECTURAL FIELDS is a high-speed direct reproduction machine. Known as Copyflex Model 500, the machine offers a 30% greater speed range, improved print stacking features, and a drive control



Copyflex Model 500

which utilizes selenium rectifiers in place of vacuum tubes. This unit, equipped with a 4,000-watt quartz exposure lamp, reproduces prints up to 46 in. wide by any length at a speed range from 14 in. to 40 ft per minute. Features for operator comfort include an extra-large front delivery



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TIDE GATES

Fig. B-144-A

One of Two 48" Type M Gates installed in Ft. Stanton Park Reservoir, Washington, D. C., to maintain direction of flow. See Feb. 22, 1944, issue Engineering News Record for story about this project.

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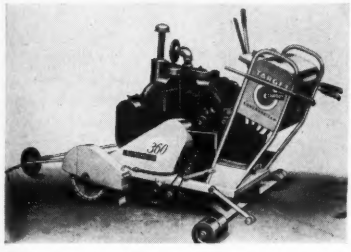
EQUIPMENT MATERIALS and METHODS

(continued)

tray, a rear tray with adjustable magnetic stops, a patented air-jet device for positive separation of originals from copies, a foot lever which releases stock in the machine when realigning or removal is desired, and an adjustable exposure lamp shield for processing extra-fast-printing originals. **Charles Bruning Company, Inc., CE 7-122-123 4702 Montrose Ave., Chicago 41, Ill.**

Concrete Saw

POWERED BY A 36 HP FOUR-CYLINDER ENGINE, the self-propelled Model 360 concrete saw is reported to be the most powerful ever manufactured. Forward speeds of 1 to 25 ft per minute are at the finger-tip control of the operator who can adjust to the speed at which the blade cuts with maximum efficiency. Hydraulic pressure "feeds" the blade into the concrete as gently, or as fast, as the operator desires, and hydraulic force lifts the blade out of the cut in one sweep at the end of the cut. Blade depth can be adjusted while the saw is in motion; a revolving pointer with indicator for 12 in., 14 in. and 18 in. blades visually record the sawing depth as the blade is hydraulically lowered or raised. **Robert G. Evans Co., CE 7-123, 7204 Wyandotte, Kansas City 14, Mo.**



Model 360

Surveyor's Compass

A SURVEYOR'S COMPASS WITH A 27X AR COATED TELESCOPE, VERTICAL CIRCLE, GLASS RETICLE AND STADIA LINES IS NOW AVAILABLE. The instrument is especially useful for forestry surveys, exploration surveys, stadia work and for retracing old surveys. The added features of this portable instrument offer easy and accurate operation and make it a highly versatile unit. **Kern Instruments Inc., CE 7-123, 120 Grand St., White Plains, N.Y.**

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This 18-inch line of Naylor Spiralweld pipe was installed to place more than 500,000 cubic yards of sand and gravel for a highway fill. The light weight of this distinctive pipe simplified installation at the new road level. At the same time, the extra strength and safety built into the Naylor structure assured the trouble-free delivery of the sand and gravel required.

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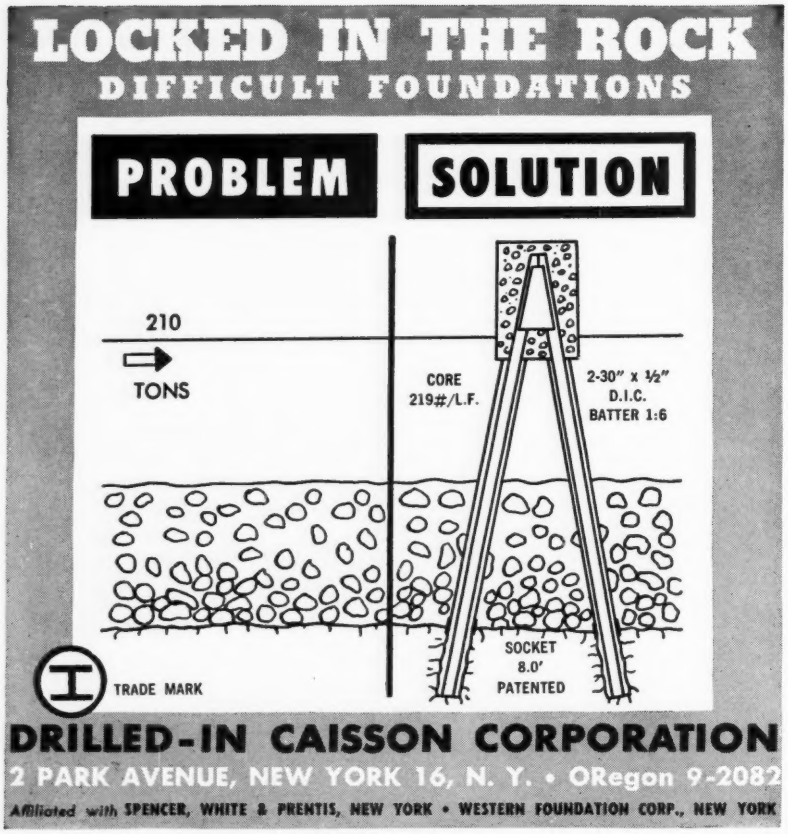

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LITERATURE AVAILABLE

COMPOSITE METAL—A composite metal having an integral and continuous bond and produced by a revolutionary high vacuum brazing process is described in a 4 page leaflet, "Hortonclad." Hortonclad provides the most complete line of clad steels for use in fabrication of process and storage vessels. A wide variety of metals and alloys that have not previously been available are now possible with Hortonclad. **Chicago Bridge & Iron Company, CE 7-124, 332 South Michigan Ave., Chicago 4, Ill.**

HIGHWAY PRODUCTS—The uses of granite for highway purposes are discussed in a 24-page catalog. Besides giving technical data, the book indicates the advantages of granite products. They are almost indestructible in withstanding the actions of abrasion, freezing and thawing, and the impact of heavy equipment. On the highway granite contributes to safety by reflecting light and defining boundaries. **H. E. Fletcher Co., CE 7-124, West Chelmsford, Mass.**

WALKING DRAGLINE—Devoted exclusively to draglines ranging in size from 5 to 15 cubic yd capacity is a detailed 16-page catalog. Each working mechanism, its function, features and capabilities are covered. Specifications are given for each model, and cover boom length, bucket capacity, maximum load capacity, hoist line speed, engine bore, stroke, horsepower and working weight. The catalog also contains many application photographs showing dragline operations. **Page Engineering Company, CE 7-124, Clearing Post Office, Chicago 38, Ill.**

ROOF DECKS—Two folders on Ingersoll roof decks are available, one on the aluminum roof deck and another on the porcelain enameled deck. Both are full floating, modular systems based on column spacing. Each eliminates field painting, reduces maintenance costs and improves lighting. **Reflectal Corporation, subsidiary of Borg-Warner Corp., CE 7-124, 310 So. Michigan Ave., Chicago 4, Ill.**

ABNEY LEVEL—An Abney Level Handbook, written by Martin P. Coopey, Professor of Civil Engineering, Oregon State College, offers concise comprehensive instructions and illustrated methods for use of this versatile level. The Abney Level is a precision-built instrument which has innumerable uses and users. It is used by surveyors, logging engineers, foresters and irrigators for topographic mapping; leveling; locating low standard roads; measuring heights of trees, poles, clearances for over-head wires, and many other general surveying purposes. There are four types of graduated arcs for the level: per cent, degree, topographic and chainage corrections. **Leupold & Stevens Instruments, Inc., CE 7-124, 4445 N. E. Glisan St., Portland 13, Oregon.**

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LITERATURE AVAILABLE (Continued)

METAL GRATING—A 16-page Data and Specification Manual, which took over $1\frac{1}{2}$ years to prepare, covers all types of grating, open steel floor armor, stair treads, vessel liners, bridge decking and drain grates. It is believed to be the most technical book of its type ever developed in the grating industry. The publication contains safe load tables for all basic types of gratings, panel width constant charts, tables on standard widths and types of steel stair treads most frequently used, types of anchors used for grating, use of grating and its allied products in industry and the oil and chemical fields, tables on bridge decking and various types of drain grates. **Klemp Metal Grating Corporation, CE 7-125, 6605 South Melvina Ave., Chicago 38, Ill.**

FILTER PLANT GAUGES—Bulletin No. 1002 features a line of filter plant gauges which can be utilized for the measurement of effluent flow, loss of head, wash water, elevation and percent of filter bed expansion. Throughout its 20 pages, the bulletin describes the various types of meters and includes facts on operation, construction, general information, sizes and capacities, specifications and other pertinent data of interest to consulting plant engineers, purchasing engineers and plant operating personnel. **Simplex Valve & Meter Company, CE 7-125, 7 East Orange St., Lancaster, Pa.**

TWO-STAGE PUMPS—Construction features are illustrated in Bulletin No. C-1054, describing the Two-Stage Type DMD Pumps. It includes dimension tables for various pump sizes. The two-stage pumps find general acceptance in high head water works, buildings, hydraulic elevators, oil refineries, mines, chemical plants, boiler feeding and many other allied fields where head requirements exceed single stage pump capabilities. Designed in sizes from 2″ to 10″ discharge for capacities to 4000 GPM and for heads to 750 ft, they are compact and serviceable units. **C. H. Wheeler Manufacturing Co., Economy Pumps Division, CE 7-125, 19th and Lehigh, Philadelphia 32, Pa.**

WATER AND SEWAGE TREATMENT—Two bulletins, covering items in their line of water, industrial water and sewage treatment equipment, have just been released. Bulletin 9W65 presents a complete picture of Circular Collectors, including tractor drive units, pier-supported and bridge-supported mechanisms. Details on Diffusair aeration equipment are given in Bulletin 22S61. Applications of the equipment include activated sludge aeration, aerobic digestion, CO_2 diffusion, pre-aeration and others. **Walker Process Equipment Inc., CE 7-125, P. O. Box 266, Aurora, Ill.**

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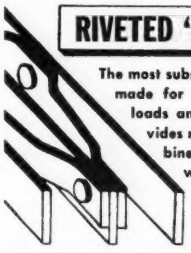

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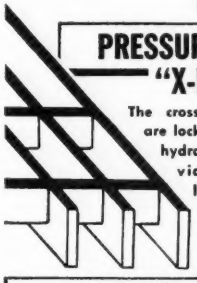

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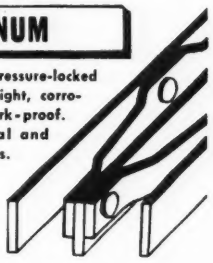

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$5000 CRACKS: Sigma welding is repairing cracks in the world's second largest pump impellers and is saving $5000 per pump in replacement costs. 125 repair welds have been made to date at the Tracy Pumping Plant in California's Central Valley Irrigation Project. . .**AT THE FAIR:** American attendance at the May British Industries Fair, at both the consumer goods section in London and the heavy industry division in Birmingham, was reported excellent. The emphasis in overseas buying at Birmingham shifted from the purchase of capital to maintenance equipment. . .**POWER PURCHASE:** The Power Authority of the State of New York approves a contract with changes for the sale of St. Lawrence Project power to the Aluminum Company of America. . .**6 NEW DIVISIONS:** Allis-Chalmers establishes six major operating divisions to simplify administration and provide faster service. Headed by J. L. Singleton, three will be in the industries group. The rest, headed by W. G. Scholl, will be in the tractor group. . .**THREE-MILE PAINT JOB:** New York's Triborough Bridge is getting three new coats on a re-paint project. Last painted in 1946–47, the bridge requires 56,000 gallons of paint for its three miles of highway structures. . .**MEDAL AWARD:** Arthur P. Woods, Jr., senior research engineer at Armco Steel Corporation, receives the American Iron and Steel Institute Medal. This annual award goes to the author of the most significant technical paper prepared in the steel industry. Woods' paper was "Some Statistical Methods Used in Studies of Steel Plant Operations.". . .**SAFETY CITATION:** The National Safety Council recognizes H. B. Alexander of the construction firm of H. B. Alexander & Son, Inc., Harrisburg, Pa., for "Meritorious Service" in the promotion of accident prevention in the construction industry. . .**ELECTIONS:** Austin R. Zender, Executive Vice President of Bridgeport Brass Company, Bridgeport, Conn., becomes President of the Copper & Brass Research Association. . .Frank F. Elliott is President of Crane Co., Chicago. . .The Fairbanks Co. of New York elects Alexander L. Naylor President. . .Elected Vice President of the Rodney Hunt Machine Co. is Jack W. Rembe. . .Herbert J. Knudten, President of Universal Engineering Company, Cedar Rapids, Iowa, is now vice president of the concern's parent company, Pettibone Mulliken Corp. of Chicago. . . **APPOINTMENTS:** Robert F. Bourne serves in a newly created position as Director of Sales for national accounts of the Colorado Fuel and Iron Corporation. . .J. T. Black is now general superintendent of Connors Steel Division plant. . . Milton G. Peck becomes vice president and director of sales and advertising at Gar Wood Industries, Inc. . .Executive Vice-President of the Seaman-Andwall Corp. is William D. Murphy. . .

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702. Traffic Diversion to Toll Roads, by John T. Lynch. (HW) Some results of traffic studies pertaining to the Maine and Pennsylvania turnpikes made by the Bureau of Public Roads in cooperation with the state highway departments are presented. Volume counts and trip origins and destinations are analyzed, giving information about the diversion, generation, and growth of traffic.

703. The Highway Spiral for Combining Curves of Different Radii, by Paul Hartman. (HW) In this paper are derived rigorous equations for the highway spiral connecting circular arcs of different radii, which show the extent of the approximations involved in the theory of the osculating circle. Graphs based on the equations permit rapid and accurate determination of the corrections to be applied to values obtained from the theory. With a working knowledge of the theory, the determination and application of these corrections are straightforward and simple. The derivations are outlined in sufficient detail to permit checking.

704. Discussion of Proceedings Papers 482, 499, 500, 596, 597, 598. (HW)

705. Water Rights in Humid Areas, by Howard T. Critchlow. (IR) This paper presents data and information on the legal control of water and on irrigation practice in the 31 eastern states. The information was obtained from replies to a brief questionnaire. Results of the survey indicate the continuing use of the riparian doctrine, with certain modifications, in the humid eastern states. The increasing use of water for supplemental irrigation is only one reason why many of these states should be preparing legislation that will equitably meet the growing demands for water.

706. General Aspects of Planned Ground Water Utilization, by Robert O. Thomas. (IR) The legal status of ground waters in California and the present development of ground water supplies are described with particular reference to current problems caused by haphazard development. An organization for control and use of available water supplies through the coordinated use of surface and ground water storage capacity is recommended, and the probable outstanding problems of such coordinated operations are indicated. An example of the benefits of the planned utilization of underground storage is given.

707. The Irrigation Aspects of Ground-Water Development, by H. R. McDonald. (IR) The advantages of the coordinated use of surface and ground water for irrigation have not yet been fully realized. Generally only about half the water diverted from streams is used by crops. The paper points out the advantages of ground-water pumping to reduce losses, to prevent or reduce drainage problems, and to irrigate additional lands where conditions are favorable for the development of large-capacity wells.

708. Hydraulics of Wells, by Dean F. Peterson, Jr. (IR) The paper reviews the development of theoretical well hydraulics and certain aspects of the application of these developments to practical problems. Considerable information is available regarding the hydraulics of well components and hydrodynamic details existing near the well. Much research is needed, however, principally for better understanding of hydrodynamic conditions near the well and through the well components and for relating such information to natural geologic conditions and practical well engineering.

709. Discussion of Proceedings Papers 432, 535, 536, 566. (HY)

710. Is Subsidy Necessary for Adequate Mass Transit? by Charles E. De Leuw. (CP) A major problem confronting city planners is that of moving people in city areas. The problem might be solved if a proper balance between mass transportation and that by individual automobile could be determined so that existing street systems could accommodate both with reasonable facility. The cost of mass transportation facilities results in discouraging investment in them. The paper challenges the profession to preserve needed mass transportation facilities.

711. The Development of the Mission Bay-San Diego River Project, by Glenn A. Rick. (CP) Plans for the development of the Mission Bay area of San Diego are described as well as the steps involved in initiating the project. The plans provide both for flood control for the San Diego River and for the conversion of worthless swamplands within the city to a valuable area which will provide a variety of recreational facilities.

712. The San Francisco Bay Area Mass Rapid Transit Study, by R. F. Ziegenfelder. (CP) Outlining the basic concepts and standards of a rapid transit system, this paper describes the current nine-county feasibility study for a coordinated system in the Bay area. A brief history of the rapid transit study and some data on the origin and destination studies are given, and the various planning studies and population projection work accomplished during the first year and a half are described.

713. Discussion of Proceedings Papers 423, 508, 509, 510. (CP)

714. Tidal Computations in Shallow Water, by J. J. Dronkers and J. C. Schonfeld. (HY) The computation of tidal elevations and currents in shallow coastal waters may serve various purposes. Mathematically the problem is so involved that no simple procedure exists. Three ways of approach are illustrated. The computation methods developed in Europe—particularly those in the Netherlands—are described.

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715. Computation of Tides and Tidal Currents—United States Practice, by H. A. Einstein and R. A. Fuchs. (HY) This paper presents a critical analysis of the methods used in the United States to compute tidal stages and flows in canals and estuaries. The methods of Parsons, Brown, and Pillsbury are compared with respect to their assumptions, advantages, and shortcomings.

716. Tidal Currents at Inlets in the United States, by Joseph M. Caldwell. (HY) Tidal currents at inlets along the coasts of the United States are classified into three basic types, and tabulations are made of each type showing pertinent tide and current data. The hydraulic characteristics of the three types are discussed, and rudimentary formulas giving the basic variables controlling the inlet velocities are set forth.

717. Estuarine Circulation Patterns, by D. W. Pritchard. (HY) Arguments indicating a sequence of estuarine types, each with a distinct density stratification and circulation pattern, are presented. Other things being equal, an estuary tends to shift from type A (highly stratified) through type B (moderately stratified) to type C or D (vertically homogeneous) with decreasing river flow, increasing tidal velocities, increasing width, and decreasing depth.

718. Discussion of Proceedings Papers 360, 386, 416, 435, 445, 548, 549, 570, 571. (SM)

719. Discussion of Proceedings Papers 483, 534, 536, 564, 565. (HY)

720. The Effect of Traffic upon Runway Pavement Cross-Section, by Robert Horonjeff and John Hugh Jones. (AT) There is some question as to whether it is necessary to construct runway pavements uniformly thick across their entire widths since traffic at many airports is concentrated at the center of the runway. This paper shows the actual transverse traffic distribution at several large airports and attempts to relate this distribution to pavement thickness.

721. Future Development of the Metropolitan Oakland International Airport, by Joseph G. Bastow. (AT) This paper is a review of a report by a group of airport consultants. The traffic survey indicates a 400% growth by 1970. Specific recommendations are a new 8,600-ft runway, a two-level terminal building, and provision for twelve gate positions. The total cost of the improvements will be $11,500,000, to be spent over a 3-yr period.

722. A New Look at the Specifications for Federal Geodetic Control, by Robert H. Randall. (SU) Because of the many improvements that have occurred in the practice of surveying in the past two decades it has become necessary to formulate new specifications for accuracy and control. The most noticeable changes are the introduction of a new high-accuracy order of control, the establishment of specific standards for fourth-order control, and the introduction of a fifth-order category for nonstandard or substandard control.

723. Federal Participation in Small-Craft Harbors, by Lyman A. Markel. (WW) The general extent of federal participation in small-craft harbors is considered in particular regard to the policy established for the evaluation and allocation of benefits and costs for such projects. Several examples of small-craft harbors in California are cited to illustrate current policies.

724. Proposed Modern Marine Terminal at San Diego, by Joachim E. Liebmann. (WW) The Port of San Diego will construct a marine terminal to eliminate congestion of present facilities. Plans call for a quay or marginal wharf 2,600 ft long with extensive covered storage space and wide roadways and loading areas. The wharf structure will be a Cyclopean concrete gravity wall retaining the dredger fill. Consideration has been given to the efficient handling of cargo as well as to lasting and economical construction.

725. Design Problems—Alamitos Bay Marina, by George F. Nicholson. (WW) The paper describes the problems considered during the design of this project. A model study, harbor capacity, automobile parking, accessibility, wave action, ground swells, current control, silting, littoral drift, circulation, and maintenance of new construction are considered, and the selection of materials is discussed. Facilities provided include boat moorings, fueling, haul out, boat repair, and yacht club sites. Lease operations and plans for future expansion are also outlined and discussed.

726. Discussion of Proceedings Papers 503, 611, 612. (WW)

727. The Design of Piers, Jetties, and Dolphins, by David A. Hopkins. (WW) This paper deals with the design of piers, jetties, and dolphins and particularly with the lateral loads from berthing ships which these structures must withstand. Design principles are discussed, and two examples of pier design are reviewed. It is shown how the impact energy of a berthing ship may be absorbed by the elastic deformation of the structure without the need for any special system for spring fendering.

728. Measurement of Canal Seepage, by A. R. Robinson and Carl Rohwer. (IR) The results of an evaluation of some methods used for determining the amount of seepage and for locating seepage are reported in this paper. It also contains information about the influence of various factors on the seepage rate. Tests were made under controlled conditions, using seepage rings for which the seepage rate and the effect of different factors could be accurately determined. In some cases field tests also were made.

729. Irrigation and Drainage Problems in Haiti, by George H. Hargreaves. (IR) The present conditions and future possibilities of water resources in Haiti and the required studies and investigations are considered. The Artibonite Project for the development of 38,400 kw of electrical energy and the irrigation of 85,000 acres of fertile valley lands is described. This paper also presents some of the problems met in water resource development in Haiti.

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